

Additional File 3

An epithelial-mesenchymal transition model recovers and predicts critical mutations underlying hepatic cancer stem cells emergence

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Reduction calculations and logic rules of simplified model

In this file we present the entire process to reduce extended model as well as the final logic rules of the simplified model. In these expressions, the symbols {!, &, |} are {NOT, AND, OR} operators, respectively.

hEMT model reduction

Reduction order = EED, SUZ12, PML, MDM2, CDK2, CDK4, CDK6, TAK1, RKIP, TNFa, IL_6, FOXC2, Ikb, GATA6, TWIST, miR200ab, miR34a, miR200c, KLF4, cMyc, p14, TELasa.

Deleted node = EED

$EED = E2F \ \& \ cMyc$

EED regulated nodes = p14, p16

$p14 = ((\neg EED \mid \neg SUZ12) \ \& \ \neg EZH2 \ \& \ \neg BMI1$

$p14 \text{ new function} = (\neg (E2F \ \& \ cMyc) \mid \neg SUZ12) \ \& \ \neg EZH2 \ \& \ \neg BMI1 = (\neg E2F \mid \neg cMyc \mid \neg SUZ12) \ \& \ \neg EZH2 \ \& \ \neg BMI1$

$p16 = (\neg SNAI2 \mid \neg BMI1) \ \& \ \neg SUZ12 \ \& \ \neg EZH2 \ \& \ \neg EED$

p16 new function = (!SNAI2 | !BMI1) & !Suz12 & !EZH2 & !(E2F & cMyc) = (!SNAI2 |
!BMI1) & !Suz12 & !EZH2 & (E2F | !cMyc)

Deleted node = SUZ12

SUZ12 = E2F & cMyc

EED regulated nodes= p14, p16

p14 = (E2F | !cMyc | !SUZ12) & !EZH2 & !BMI1

p14 new function = (E2F | !cMyc | !(E2F & cMyc)) & !EZH2 & !BMI1 = (E2F | !cMyc | E2F
| !cMyc) & !EZH2 & !BMI1 = (E2F | !cMyc) & !EZH2 & !BMI1

p16 = (!SNAI2 | !BMI1) & !SUZ12 & !EZH2 & (E2F | !cMyc)

p16 new function = (!SNAI2 | !BMI1) & !(E2F & cMyc) & !EZH2 & (E2F | !cMyc) = (!SNAI2
| !BMI1) & (E2F | !cMyc) & !EZH2 & (E2F | !cMyc) = (!SNAI2 | !BMI1) & (E2F | !cMyc) &
!EZH2

Deleted node = PML

PML = p53

PML regulated nodes = MDM2

MDM2 = (p53 | TGFB | NFkB) & !PML & !p14 & !p16

MDM2 new function = (p53 | TGFB | NFkB) & !p53 & !p14 & !p16 = (TGFB | NFkB) & !p53
& !p14 & !p16

Deleted node = MDM2

MDM2 = (TGFB | NFkB) & !p53 & !p14 & !p16

MDM2 regulated nodes = p53, EZH2

p53 = ((KLF4 | HNF6 | p53) & !MDM2 & (!OCT4 | !miR34a | !TWIST | !SNAI1)) | (NFkB &
!MDM2 & !miR34a & !OCT4)

p53 new function = ((KLF4 | HNF6 | p53) & !((TGFB | NFkB) & !p53 & !p14 & !p16) &
(!OCT4 | !miR34a | !TWIST | !SNAI1)) | (NFkB & !((TGFB | NFkB) & !p53 & !p14 & !p16) &
!miR34a & !OCT4) = ((KLF4 | HNF6 | p53) & !(TGFB | NFkB) | p53 | p14 | p16) & (!OCT4 |
!miR34a | !TWIST | !SNAI1)) | (NFkB & !(TGFB | NFkB) | p53 | p14 | p16) & !miR34a &
!OCT4) = ((KLF4 | HNF6 | p53) & !(TGFB | NFkB) | p53 | p14 | p16) & (!OCT4 | !miR34a |
!TWIST | !SNAI1)) | (NFkB & !(TGFB | NFkB) | p53 | p14 | p16) & !miR34a & !OCT4)

$EZH2 = ((E2F \mid cMyc \mid Bcatenin \mid MDM2) \& !p53) \mid (E2F \& cMyc \& Bcatenin)$

$EZH2 \text{ new function} = ((E2F \mid cMyc \mid Bcatenin \mid ((TGFB \mid NFkB) \& !p53 \& !p14 \& !p16)) \& !p53) \mid (E2F \& cMyc \& Bcatenin) =$

Deleted node = CDK2

$CDK2 = !p16 \& !p21$

CDK2 regulated nodes = RB

$RB = !CyclinD \mid !(CDK4 \mid CDK2 \mid CDK6)$

$RB \text{ new function} = !CyclinD \mid !(CDK4 \mid (!p16 \& !p21) \mid CDK6)$

Deleted node = CDK4

$CDK4 = !p16 \& !p21$

CDK2 regulated nodes = RB

$RB = \neg CyclinDD \mid \neg(CDK4 \mid (\neg p16 \ \& \ \neg p21) \mid CDK6)$

$RB \text{ new function} = \neg CyclinD \mid \neg((\neg p16 \ \& \ \neg p21) \mid (\neg p16 \ \& \ \neg p21) \mid CDK6) = \neg CyclinD \mid \neg((\neg p16 \ \& \ \neg p21) \mid CDK6)$

Deleted node = CDK6

$CDK6 = \neg p16 \ \& \ \neg p21$

CDK6 regulated nodes = RB

$RB = \neg CyclinD \mid \neg(\neg p16 \ \& \ \neg p21) \mid CDK6$

$RB \text{ new function} = \neg CyclinD \mid \neg((\neg p16 \ \& \ \neg p21) \mid (\neg p16 \ \& \ \neg p21)) = \neg CyclinD \mid \neg(\neg p16 \ \& \ \neg p21) = \neg CyclinD \mid p16 \mid p21$

Deleted node = TAK1

$TAK1 = TGFB$

TAK1 regulated nodes = Ikb

$I\kappa B = (NF\kappa B \mid !TAK1) \ \& \ !TNF\alpha \ \& \ !IL_6$

$I\kappa B \text{ new function} = (NF\kappa B \mid !TGFB) \ \& \ !TNF\alpha \ \& \ !IL_6$

Deleted node = RKIP

$RKIP = !SNAI1$

RKIP regulated nodes = NFκB

$NF\kappa B = !I\kappa B \mid !HNF4A \mid !HNF1A \mid !p53 \mid !RKIP$

$NF\kappa B \text{ new function} = !I\kappa B \mid !HNF4A \mid !HNF1A \mid !p53 \mid !(SNAI1) = !I\kappa B \mid !HNF4A \mid !HNF1A \mid !p53 \mid SNAI1$

Deleted node = TNFα

$TNF\alpha = !TWIST \ \& \ !FOXA2 \ \& \ NF\kappa B$

TNFα regulated nodes = IκB

$I\kappa B = (NF\kappa B \mid !TGFB) \ \& \ !TNF\alpha \ \& \ !IL_6$

IkB new function = (NFkB | !TGFB) & !(TWIST & !FOXA2 & NFkB) & !IL_6 = (NFkB | !TGFB) & (TWIST | FOXA2 | !NFkB) & !IL_6

Deleted node = IL_6

IL_6 = (NFkB & !FOXA2 & !TWIST) | KLF4 | YAP1 | (SNAI1 & NFkB)

IL_6 regulated nodes = IkB

IkB = (NFkB | !TGFB) & (TWIST | FOXA2 | !NFkB) & !IL_6

IkB new function = (NFkB | !TGFB) & (TWIST | FOXA2 | !NFkB) & !((NFkB & !FOXA2 & !TWIST) | KLF4 | YAP1 | (SNAI1 & NFkB)) =

(NFkB | !TGFB) & (TWIST | FOXA2 | !NFkB) & !(NFkB & !FOXA2 & !TWIST) & !KLF4 & !YAP1 & !(SNAI1 & NFkB)

Deleted node = FOXC2

FOXC2 = (TWIST | SNAI1) & NFkB

FOXC2 regulated nodes = ZEB1

ZEB1 = ((SNAI1 | SNAI2 | TWIST | Bcatenin | FOXC2 | NFkB) & !HNF1A & (!GATA6 | !miR200ab | !miR34a | !miR200c)) | (SNAI1 & SNAI2 & NFkB & !HNF1A)

ZEB1 new function = ((SNAI1 | SNAI2 | TWIST | Bcatenin | ((TWIST | SNAI1) & NFkB) | NFkB) & !HNF1A & (!GATA6 | !miR200ab | !miR34a | !miR200c)) | (SNAI1 & SNAI2 & NFkB & !HNF1A)

Deleted node = IkB

IkB regulated nodes = NFkB

IkB = (NFkB | !TGFB) & (TWIST | FOXA2 | !NFkB) & !(NFkB & !FOXA2 & !TWIST) & !KLF4 & !YAP1 & !(SNAI1 & NFkB)

NFkB = !IkB | !HNF4A | !HNF1A | !p53 | SNAI1

NFkB new function = !((NFkB | !TGFB) & (TWIST | FOXA2 | !NFkB) & !(NFkB & !FOXA2 & !TWIST) & !KLF4 & !YAP1 & !(SNAI1 & NFkB)) | !HNF4A | !HNF1A | !p53 | SNAI1 =
!(NFkB | !TGFB) | !(TWIST | FOXA2 | !NFkB) | (NFkB & !FOXA2 & !TWIST) | KLF4 | YAP1
| (SNAI1 & NFkB) | !HNF4A | !HNF1A | !p53 | SNAI1 =

(!NFkB & TGFB) | (!TWIST & !FOXA2 & NFkB) | (NFkB & !FOXA2 & !TWIST) | KLF4 |
YAP1 | (SNAI1 & NFkB) | !HNF4A | !HNF1A | !p53 | SNAI1 =

$(\neg \text{NFkB} \ \& \ \text{TGFB}) \mid (\neg \text{TWIST} \ \& \ \neg \text{FOXA2} \ \& \ \text{NFkB}) \mid (\text{NFkB} \ \& \ \neg \text{FOXA2} \ \& \ \neg \text{TWIST}) \mid \text{KLF4} \mid$

$\text{YAP1} \mid \neg \text{HNF4A} \mid \neg \text{HNF1A} \mid \neg \text{p53} \mid \text{SNAI1} =$

$(\neg \text{NFkB} \ \& \ \text{TGFB}) \mid (\neg \text{TWIST} \ \& \ \neg \text{FOXA2} \ \& \ \text{NFkB}) \mid \text{KLF4} \mid \text{YAP1} \mid \neg \text{HNF4A} \mid \neg \text{HNF1A} \mid \neg \text{p53} \mid$

SNAI1

Deleted node = GATA6

GATA6 regulated nodes = SNAI1, ZEB1, FOXA2, OCT4, NANOG, TGFB, HNF4A

$\text{GATA6} = \neg \text{NANOG} \ \& \ \neg \text{cMyc} \ \& \ \neg \text{KLF4} \ \& \ \text{SOX2}$

$\text{SNAI1} = ((\text{TGFB} \mid \text{NFkB} \mid \text{cMyc} \mid \text{YAP1}) \ \& \ (\neg \text{SNAI1} \mid \neg \text{SNAI2} \mid \neg \text{GATA6}) \ \& \ \neg \text{miR34a} \ \& \ (\neg \text{HNF4A} \mid \neg \text{HNF1A})) \mid (\text{NFkB} \ \& \ \text{cMyc} \ \& \ \neg \text{miR34a} \ \& \ \neg \text{HNF4A} \ \& \ \neg \text{HNF1A}) \mid (\text{TGFB} \ \& \ \text{NFkB} \ \& \ (\text{cMyc} \mid \text{YAP1})) \mid (\text{NFkB} \ \& \ \neg \text{HNF4A} \ \& \ \neg \text{HNF1A}) \mid ((\text{NANOG} \mid \text{OCT4}) \ \& \ (\neg \text{HNF4A} \mid \neg \text{HNF1A}) \ \& \ (\text{YAP1} \mid \text{cMyc})) \mid (\text{NFkB} \ \& \ \neg \text{miR34a} \ \& \ \neg \text{HNF1A})$

$\text{SNAI1 new function} = ((\text{TGFB} \mid \text{NFkB} \mid \text{cMyc} \mid \text{YAP1}) \ \& \ (\neg \text{SNAI1} \mid \neg \text{SNAI2} \mid \neg (\neg \text{NANOG} \ \& \ \neg \text{cMyc} \ \& \ \neg \text{KLF4} \ \& \ \text{SOX2}))) \ \& \ \neg \text{miR34a} \ \& \ (\neg \text{HNF4A} \mid \neg \text{HNF1A})) \mid (\text{NFkB} \ \& \ \text{cMyc} \ \& \ \neg \text{miR34a} \ \& \ \neg \text{HNF4A} \ \& \ \neg \text{HNF1A}) \mid (\text{TGFB} \ \& \ \text{NFkB} \ \& \ (\text{cMyc} \mid \text{YAP1})) \mid (\text{NFkB} \ \& \ \neg \text{HNF4A} \ \& \ \neg \text{HNF1A}) \mid ((\text{NANOG} \mid \text{OCT4}) \ \& \ (\neg \text{HNF4A} \mid \neg \text{HNF1A}) \ \& \ (\text{YAP1} \mid \text{cMyc})) \mid (\text{NFkB} \ \& \ \neg \text{miR34a} \ \& \ \neg \text{HNF1A})$
 $= ((\text{TGFB} \mid \text{NFkB} \mid \text{cMyc} \mid \text{YAP1}) \ \& \ (\neg \text{SNAI1} \mid \neg \text{SNAI2} \mid \text{NANOG} \mid \text{cMyc} \mid \text{KLF4} \mid \neg \text{SOX2}) \ \& \ \neg \text{miR34a} \ \& \ (\neg \text{HNF4A} \mid \neg \text{HNF1A})) \mid (\text{NFkB} \ \& \ \text{cMyc} \ \& \ \neg \text{miR34a} \ \& \ \neg \text{HNF4A} \ \& \ \neg \text{HNF1A}) \mid (\text{TGFB}$

& NFkB & (cMyc | YAP1)) | (NFkB & !HNF4A & !HNF1A) | ((NANOG | OCT4) & (!HNF4A | !HNF1A) & (YAP1 | cMyc)) | (NFkB & !miR34a & !HNF1A)

ZEB1 = ((SNAI1 | SNAI2 | TWIST | Bcatenin | ((TWIST | SNAI1) & NFkB) | NFkB) & !HNF1A & (!GATA6 | !miR200ab | !miR34a | !miR200c)) | (SNAI1 & SNAI2 & NFkB & !HNF1A)

ZEB1 new function = ((SNAI1 | SNAI2 | TWIST | Bcatenin | ((TWIST | SNAI1) & NFkB) | NFkB) & !HNF1A & (!(!NANOG & !cMyc & !KLF4 & SOX2) | !miR200ab | !miR34a | !miR200c)) | (SNAI1 & SNAI2 & NFkB & !HNF1A) = ((SNAI1 | SNAI2 | TWIST | Bcatenin | ((TWIST | SNAI1) & NFkB) | NFkB) & !HNF1A & (NANOG | cMyc | KLF4 | !SOX2 | !miR200ab | !miR34a | !miR200c)) | (SNAI1 & SNAI2 & NFkB & !HNF1A) = ((SNAI1 | SNAI2 | TWIST | Bcatenin | NFkB) & !HNF1A & (NANOG | cMyc | KLF4 | !SOX2 | !miR200ab | !miR34a | !miR200c)) | (SNAI1 & SNAI2 & NFkB & !HNF1A)

FOXA2 = ((HNF4A | HNF6) & (GATA6 | FOXA2 | SOX9 | Bcatenin) & !SOX2 & (!TGFB | !miR200ab)) | (HNF4A & (FOXA2 | HNF6 | GATA6) & !SOX2 & !TGFB)

FOXA2 new function = ((HNF4A | HNF6) & (!NANOG & !cMyc & !KLF4 & SOX2) | FOXA2 | SOX9 | Bcatenin) & !SOX2 & (!TGFB | !miR200ab)) | (HNF4A & (FOXA2 | HNF6 | (!NANOG & !cMyc & !KLF4 & SOX2)) & !SOX2 & !TGFB) = ((HNF4A | HNF6) & (!NANOG & !cMyc & !KLF4 & SOX2) | FOXA2 | SOX9 | Bcatenin) & !SOX2 & (!TGFB | !miR200ab)) | (HNF4A & (FOXA2 | HNF6) & !SOX2 & !TGFB) = ((HNF4A | HNF6) & (FOXA2 | SOX9 |

Bcatenin) & !SOX2 & (!TGFB | !miR200ab)) | (HNF4A & (FOXA2 | HNF6) & !SOX2 & !TGFB)

OCT4 = (SOX2 & NANOG & !p53 & !RB & (!GATA6 | !miR34a)) | ((SOX2 | NANOG) & (OCT4 | KLF4) & YAP1 & !p53)

OCT4 new function = (SOX2 & NANOG & !p53 & !RB & (!(!NANOG & !cMyc & !KLF4 & SOX2) | !miR34a)) | ((SOX2 | NANOG) & (OCT4 | KLF4) & YAP1 & !p53) = (SOX2 & NANOG & !p53 & !RB & (NANOG | cMyc | KLF4 | !SOX2 | !miR34a)) | ((SOX2 | NANOG) & (OCT4 | KLF4) & YAP1 & !p53) = (SOX2 & NANOG & !p53 & !RB) | ((SOX2 | NANOG) & (OCT4 | KLF4) & YAP1 & !p53)

NANOG = ((SOX2 | OCT4) & (KLF4 | NANOG) & !SNAI1 & (!GATA6 | !miR34a) & !p53) | (SOX2 & OCT4 & (NFkB | TGFB) & !p53) | (OCT4 & NANOG & NFkB & !miR34a & !p53) | (SOX2 & NANOG & NFkB & !miR34a & !p53) | (!SNAI1 & !GATA6 & !miR34a & !NANOG & !NFkB & !p53 & !KLF4 & !TGFB & SOX2 & OCT4)

NANOG new function = ((SOX2 | OCT4) & (KLF4 | NANOG) & !SNAI1 & (!(!NANOG & !cMyc & !KLF4 & SOX2) | !miR34a) & !p53) | (SOX2 & OCT4 & (NFkB | TGFB) & !p53) | (OCT4 & NANOG & NFkB & !miR34a & !p53) | (SOX2 & NANOG & NFkB & !miR34a & !p53) | (!SNAI1 & (!(!NANOG & !cMyc & !KLF4 & SOX2) & !miR34a & !NANOG & !NFkB & !p53 & !KLF4 & !TGFB & SOX2 & OCT4) = ((SOX2 | OCT4) & (KLF4 | NANOG) & !SNAI1 & (NANOG | cMyc | KLF4 | !SOX2 | !miR34a) & !p53) | (SOX2 & OCT4 & (NFkB | TGFB) &

$$\begin{aligned} & !p53) \mid (OCT4 \ \& \ \text{NANOG} \ \& \ \text{NFkB} \ \& \ !\text{miR34a} \ \& \ !p53) \mid (\text{SOX2} \ \& \ \text{NANOG} \ \& \ \text{NFkB} \ \& \\ & \ !\text{miR34a} \ \& \ !p53) \mid (!\text{SNAI1} \ \& \ (\text{NANOG} \mid \text{cMyc} \mid \text{KLF4} \mid !\text{SOX2}) \ \& \ !\text{miR34a} \ \& \ !\text{NANOG} \ \& \\ & \ !\text{NFkB} \ \& \ !p53 \ \& \ !\text{KLF4} \ \& \ !\text{TGFB} \ \& \ \text{SOX2} \ \& \ \text{OCT4}) = ((\text{SOX2} \mid \text{OCT4}) \ \& \ (\text{KLF4} \mid \text{NANOG}) \ \& \\ & \ !\text{SNAI1} \ \& \ (\text{NANOG} \mid \text{cMyc} \mid \text{KLF4} \mid !\text{SOX2} \mid !\text{miR34a}) \ \& \ !p53) \mid (\text{SOX2} \ \& \ \text{OCT4} \ \& \ (\text{NFkB} \mid \\ & \ \text{TGFB}) \ \& \ !p53) \mid (\text{OCT4} \ \& \ \text{NANOG} \ \& \ \text{NFkB} \ \& \ !\text{miR34a} \ \& \ !p53) \mid (\text{SOX2} \ \& \ \text{NANOG} \ \& \ \text{NFkB} \\ & \ \& \ !\text{miR34a} \ \& \ !p53) \mid (!\text{SNAI1} \ \& \ \text{cMyc} \ \& \ !\text{miR34a} \ \& \ !\text{NANOG} \ \& \ !\text{NFkB} \ \& \ !p53 \ \& \ !\text{KLF4} \ \& \\ & \ !\text{TGFB} \ \& \ \text{SOX2} \ \& \ \text{OCT4}) = ((\text{SOX2} \mid \text{OCT4}) \ \& \ (\text{KLF4} \mid \text{NANOG}) \ \& \ !\text{SNAI1} \ \& \ !p53) \mid (\text{SOX2} \\ & \ \& \ \text{OCT4} \ \& \ (\text{NFkB} \mid \text{TGFB}) \ \& \ !p53) \mid (\text{OCT4} \ \& \ \text{NANOG} \ \& \ \text{NFkB} \ \& \ !\text{miR34a} \ \& \ !p53) \mid (\text{SOX2} \\ & \ \& \ \text{NANOG} \ \& \ \text{NFkB} \ \& \ !\text{miR34a} \ \& \ !p53) \mid (!\text{SNAI1} \ \& \ \text{cMyc} \ \& \ !\text{miR34a} \ \& \ !\text{NANOG} \ \& \ !\text{NFkB} \ \& \\ & \ !p53 \ \& \ !\text{KLF4} \ \& \ !\text{TGFB} \ \& \ \text{SOX2} \ \& \ \text{OCT4}) \end{aligned}$$

$$\text{TGFB} = !\text{GATA6} \ \& \ !\text{KLF4} \ \& \ \text{YAP1}$$

$$\begin{aligned} \text{TGFB new function} &= !(!\text{NANOG} \ \& \ !\text{cMyc} \ \& \ !\text{KLF4} \ \& \ \text{SOX2}) \ \& \ !\text{KLF4} \ \& \ \text{YAP1} = (\text{NANOG} \mid \\ & \ \text{cMyc} \mid \text{KLF4} \mid !\text{SOX2}) \ \& \ !\text{KLF4} \ \& \ \text{YAP1} = (\text{NANOG} \mid \text{cMyc} \mid !\text{SOX2}) \ \& \ !\text{KLF4} \ \& \ \text{YAP1} \end{aligned}$$

$$\begin{aligned} \text{HNF4A} &= ((\text{HNF1A} \mid \text{FOXA2} \mid \text{GATA6} \mid \text{HNF6} \mid \text{HNF4A}) \ \& \ !\text{SNAI1} \ \& \ !\text{SNAI2} \ \& \ (!\text{NFkB} \mid \\ & \ !\text{YAP1} \mid !p53)) \mid (\text{HNF4A} \ \& \ (\text{HNF1A} \mid \text{FOXA2} \mid \text{HNF6}) \ \& \ (!\text{SNAI2} \mid !\text{SNAI1})) \mid (\text{FOXA2} \ \& \\ & \ !\text{SNAI1} \ \& \ !\text{YAP1} \ \& \ !\text{SNAI2} \ \& \ !p53) \mid (\text{HNF1A} \ \& \ (\text{HNF4A} \mid \text{FOXA2} \mid \text{HNF6}) \ \& \ (!\text{SNAI2} \mid \\ & \ !\text{SNAI1}) \ \& \ !\text{YAP1} \ \& \ (!\text{NFkB} \mid !p53)) \end{aligned}$$

$$\begin{aligned} \text{HNF4A new function} &= ((\text{HNF1A} \mid \text{FOXA2} \mid (!\text{NANOG} \ \& \ !\text{cMyc} \ \& \ !\text{KLF4} \ \& \ \text{SOX2}) \mid \text{HNF6} \mid \\ & \ \text{HNF4A}) \ \& \ !\text{SNAI1} \ \& \ !\text{SNAI2} \ \& \ (!\text{NFkB} \mid !\text{YAP1} \mid !p53)) \mid (\text{HNF4A} \ \& \ (\text{HNF1A} \mid \text{FOXA2} \mid \end{aligned}$$

$$\text{HNF6) \& (!SNAI2 | !SNAI1)) | (FOXA2 \& !SNAI1 \& !YAP1 \& !SNAI2 \& !p53) | (HNF1A \& (HNF4A | FOXA2 | HNF6) \& (!SNAI2 | !SNAI1) \& !YAP1 \& (!NFkB | !p53))}$$

Deleted node = TWIST

TWIST regulated nodes = SNAI2, ZEB1, p53, BMI1, E2F, NFkB

TWIST = (SNAI1 | NFkB) & !miR34a

$$\text{SNAI2 = ((SOX9 | TWIST | NFkB | SNAI2) \& !HNF4A \& (!HNF1A | !FOXA2) \& (!KLF4 | !SNAI1) \& !miR200c \& !miR200ab) | ((YAP1 | Bcatenin) \& (NFkB | SNAI2) \& (!HNF4A | !HNF1A) \& !FOXA2 \& !miR200ab \& !miR200c) | (NANOG \& (YAP1 | Bcatenin) \& (TWIST | SNAI2) \& (!HNF4A | !HNF1A) \& !miR200ab \& !miR200c)}$$

$$\text{SNAI2 new function = ((SOX9 | ((SNAI1 | NFkB) \& !miR34a) | NFkB | SNAI2) \& !HNF4A \& (!HNF1A | !FOXA2) \& (!KLF4 | !SNAI1) \& !miR200c \& !miR200ab) | ((YAP1 | Bcatenin) \& (NFkB | SNAI2) \& (!HNF4A | !HNF1A) \& !FOXA2 \& !miR200ab \& !miR200c) | (NANOG \& (YAP1 | Bcatenin) \& (((SNAI1 | NFkB) \& !miR34a) | SNAI2) \& (!HNF4A | !HNF1A) \& !miR200ab \& !miR200c)}$$

ZEB1 = ((SNAI1 | SNAI2 | TWIST | Bcatenin | NFkB) & !HNF1A & (NANOG | cMyc | KLF4 | !SOX2 | !miR200ab | !miR34a | !miR200c)) | (SNAI1 & SNAI2 & NFkB & !HNF1A)

ZEB1 new function = ((SNAI1 | SNAI2 | ((SNAI1 | NFkB) & !miR34a) | Bcatenin | NFkB) & !HNF1A & (NANOG | cMyc | KLF4 | !SOX2 | !miR200ab | !miR34a | !miR200c)) | (SNAI1 & SNAI2 & NFkB & !HNF1A) = ((SNAI1 | SNAI2 | Bcatenin | NFkB) & !HNF1A & (NANOG | cMyc | KLF4 | !SOX2 | !miR200ab | !miR34a | !miR200c)) | (SNAI1 & SNAI2 & NFkB & !HNF1A)

p53 = ((KLF4 | HNF6 | p53) & !(TGFB | NFkB) | p53 | p14 | p16) & (!OCT4 | !miR34a | !TWIST | !SNAI1)) | (NFkB & !(TGFB | NFkB) | p53 | p14 | p16) & !miR34a & !OCT4

p53 new function =

((KLF4 | HNF6 | p53) & !(TGFB | NFkB) | p53 | p14 | p16) & (!OCT4 | !miR34a | !((SNAI1 | NFkB) & !miR34a) | !SNAI1)) | (NFkB & !(TGFB | NFkB) | p53 | p14 | p16) & !miR34a & !OCT4) =

((KLF4 | HNF6 | p53) & !(TGFB | NFkB) | p53 | p14 | p16) & (!OCT4 | !miR34a | ((!SNAI1 & !NFkB) | miR34a) | !SNAI1)) | (NFkB & !(TGFB | NFkB) | p53 | p14 | p16) & !miR34a & !OCT4) =

((KLF4 | HNF6 | p53) & !(TGFB | NFkB) | p53 | p14 | p16)) | (NFkB & !(TGFB | NFkB) | p53 | p14 | p16) & !miR34a & !OCT4)

BMI1 = ((E2F | cMyc) & (SOX9 | NANOG | TWIST) & !miR200c) | (E2F & cMyc) | (E2F & !miR200c)

BMI1 new function = ((E2F | cMyc) & (SOX9 | NANOG | ((SNAI1 | NFkB) & !miR34a)) & !miR200c) | (E2F & cMyc) | (E2F & !miR200c)

E2F = ((cMyc | E2F | YAP1) & !RB & !p21 & (!TWIST | !HNF4A)) | (cMyc & E2F & !RB) | (YAP1 & !p21)

E2F new function = ((cMyc | E2F | YAP1) & !RB & !p21 & (!((SNAI1 | NFkB) & !miR34a) | !HNF4A)) | (cMyc & E2F & !RB) | (YAP1 & !p21) = ((cMyc | E2F | YAP1) & !RB & !p21 & ((!(SNAI1 | NFkB) | miR34a) | !HNF4A)) | (cMyc & E2F & !RB) | (YAP1 & !p21) = ((cMyc | E2F | YAP1) & !RB & !p21 & ((!(SNAI1 & !NFkB) | miR34a | !HNF4A)) | (cMyc & E2F & !RB) | (YAP1 & !p21)

NFkB = (!NFkB & TGFB) | (!TWIST & !FOXA2 & NFkB) | KLF4 | YAP1 | !HNF4A | !HNF1A | !p53 | SNAI1

NFkB new function = (!NFkB & TGFB) | (!((SNAI1 | NFkB) & !miR34a) & !FOXA2 & NFkB) | KLF4 | YAP1 | !HNF4A | !HNF1A | !p53 | SNAI1 =

(!NFkB & TGFB) | (!((SNAI1 | NFkB) & !miR34a) & !FOXA2 & NFkB) | KLF4 | YAP1 | !HNF4A | !HNF1A | !p53 | SNAI1 =

$(\neg \text{NFkB} \ \& \ \text{TGFB}) \mid ((\neg (\text{SNAI1} \mid \text{NFkB}) \mid \text{miR34a}) \ \& \ \neg \text{FOXA2} \ \& \ \text{NFkB}) \mid \text{KLF4} \mid \text{YAP1} \mid \neg \text{HNF4A} \mid \neg \text{HNF1A} \mid \neg \text{p53} \mid \text{SNAI1} =$

$(\neg \text{NFkB} \ \& \ \text{TGFB}) \mid (((\neg \text{SNAI1} \ \& \ \neg \text{NFkB}) \mid \text{miR34a}) \ \& \ \neg \text{FOXA2} \ \& \ \text{NFkB}) \mid \text{KLF4} \mid \text{YAP1} \mid \neg \text{HNF4A} \mid \neg \text{HNF1A} \mid \neg \text{p53} \mid \text{SNAI1} =$

$(\neg \text{NFkB} \ \& \ \text{TGFB}) \mid (\text{miR34a} \ \& \ \neg \text{FOXA2} \ \& \ \text{NFkB}) \mid \text{KLF4} \mid \text{YAP1} \mid \neg \text{HNF4A} \mid \neg \text{HNF1A} \mid \neg \text{p53} \mid \text{SNAI1}$

Deleted node = miR200ab

miR200ab regulated nodes = SNAI2, ZEB1, Bcatenin, FOXA2

$\text{miR200ab} = (\text{HNF4A} \mid \text{SOX2}) \ \& \ \neg \text{ZEB1} \ \& \ \neg \text{SNAI2}$

$\text{SNAI2} = ((\text{SOX9} \mid ((\text{SNAI1} \mid \text{NFkB}) \ \& \ \neg \text{miR34a}) \mid \text{NFkB} \mid \text{SNAI2}) \ \& \ \neg \text{HNF4A} \ \& \ (\neg \text{HNF1A} \mid \neg \text{FOXA2}) \ \& \ (\neg \text{KLF4} \mid \neg \text{SNAI1}) \ \& \ \neg \text{miR200c} \ \& \ \neg \text{miR200ab}) \mid ((\text{YAP1} \mid \text{Bcatenin}) \ \& \ (\text{NFkB} \mid \text{SNAI2}) \ \& \ (\neg \text{HNF4A} \mid \neg \text{HNF1A}) \ \& \ \neg \text{FOXA2} \ \& \ \neg \text{miR200ab} \ \& \ \neg \text{miR200c}) \mid (\text{NANOG} \ \& \ (\text{YAP1} \mid \text{Bcatenin}) \ \& \ (((\text{SNAI1} \mid \text{NFkB}) \ \& \ \neg \text{miR34a}) \mid \text{SNAI2}) \ \& \ (\neg \text{HNF4A} \mid \neg \text{HNF1A}) \ \& \ \neg \text{miR200ab} \ \& \ \neg \text{miR200c})$

$\text{SNAI2 new function} = ((\text{SOX9} \mid ((\text{SNAI1} \mid \text{NFkB}) \ \& \ \neg \text{miR34a}) \mid \text{NFkB} \mid \text{SNAI2}) \ \& \ \neg \text{HNF4A} \ \& \ (\neg \text{HNF1A} \mid \neg \text{FOXA2}) \ \& \ (\neg \text{KLF4} \mid \neg \text{SNAI1}) \ \& \ \neg \text{miR200c} \ \& \ \neg ((\text{HNF4A} \mid \text{SOX2}) \ \& \ \neg \text{ZEB1} \ \& \ \neg \text{SNAI2})) \mid ((\text{YAP1} \mid \text{Bcatenin}) \ \& \ (\text{NFkB} \mid \text{SNAI2}) \ \& \ (\neg \text{HNF4A} \mid \neg \text{HNF1A}) \ \& \ \neg \text{FOXA2} \ \&$

$$\begin{aligned} &!(\text{HNF4A} \mid \text{SOX2}) \& \text{!ZEB1} \& \text{!SNAI2}) \& \text{!miR200c}) \mid (\text{NANOG} \& (\text{YAP1} \mid \text{Bcatenin}) \& \\ &(((\text{SNAI1} \mid \text{NFkB}) \& \text{!miR34a}) \mid \text{SNAI2}) \& \text{!(HNF4A} \mid \text{HNF1A)}) \& \text{!(HNF4A} \mid \text{SOX2}) \& \\ &\text{!ZEB1} \& \text{!SNAI2}) \& \text{!miR200c}) = ((\text{SOX9} \mid ((\text{SNAI1} \mid \text{NFkB}) \& \text{!miR34a}) \mid \text{NFkB} \mid \text{SNAI2}) \& \\ &\text{!HNF4A} \& \text{!(HNF1A} \mid \text{FOXA2}) \& \text{!KLF4} \mid \text{!SNAI1}) \& \text{!miR200c} \& ((\text{!HNF4A} \& \text{!SOX2}) \mid \\ &\text{ZEB1} \mid \text{SNAI2})) \mid ((\text{YAP1} \mid \text{Bcatenin}) \& (\text{NFkB} \mid \text{SNAI2}) \& \text{!(HNF4A} \mid \text{HNF1A}) \& \text{!FOXA2} \& \\ &((\text{!HNF4A} \& \text{!SOX2}) \mid \text{ZEB1} \mid \text{SNAI2}) \& \text{!miR200c}) \mid (\text{NANOG} \& (\text{YAP1} \mid \text{Bcatenin}) \& \\ &(((\text{SNAI1} \mid \text{NFkB}) \& \text{!miR34a}) \mid \text{SNAI2}) \& \text{!(HNF4A} \mid \text{HNF1A}) \& ((\text{!HNF4A} \& \text{!SOX2}) \mid \\ &\text{ZEB1} \mid \text{SNAI2}) \& \text{!miR200c}) \end{aligned}$$

$$\begin{aligned} \text{ZEB1} = &((\text{SNAI1} \mid \text{SNAI2} \mid \text{Bcatenin} \mid \text{NFkB}) \& \text{!HNF1A} \& (\text{NANOG} \mid \text{cMyc} \mid \text{KLF4} \mid \text{!SOX2} \mid \\ &\text{!miR200ab} \mid \text{!miR34a} \mid \text{!miR200c})) \mid (\text{SNAI1} \& \text{SNAI2} \& \text{NFkB} \& \text{!HNF1A}) \end{aligned}$$

$$\begin{aligned} \text{ZEB1 new function} = &((\text{SNAI1} \mid \text{SNAI2} \mid \text{Bcatenin} \mid \text{NFkB}) \& \text{!HNF1A} \& (\text{NANOG} \mid \text{cMyc} \mid \\ &\text{KLF4} \mid \text{!SOX2} \mid \text{!(HNF4A} \mid \text{SOX2}) \& \text{!ZEB1} \& \text{!SNAI2}) \mid \text{!miR34a} \mid \text{!miR200c})) \mid (\text{SNAI1} \& \\ &\text{SNAI2} \& \text{NFkB} \& \text{!HNF1A}) = \end{aligned}$$

$$\begin{aligned} &((\text{SNAI1} \mid \text{SNAI2} \mid \text{Bcatenin} \mid \text{NFkB}) \& \text{!HNF1A} \& (\text{NANOG} \mid \text{cMyc} \mid \text{KLF4} \mid \text{!SOX2} \mid \\ &\text{!(HNF4A} \mid \text{SOX2}) \mid \text{ZEB1} \mid \text{SNAI2}) \mid \text{!miR34a} \mid \text{!miR200c})) \mid (\text{SNAI1} \& \text{SNAI2} \& \text{NFkB} \& \\ &\text{!HNF1A}) = \end{aligned}$$

$$\begin{aligned} &((\text{SNAI1} \mid \text{SNAI2} \mid \text{Bcatenin} \mid \text{NFkB}) \& \text{!HNF1A} \& (\text{NANOG} \mid \text{cMyc} \mid \text{KLF4} \mid \text{!SOX2} \mid \\ &\text{!(HNF4A} \& \text{!SOX2}) \mid \text{ZEB1} \mid \text{SNAI2} \mid \text{!miR34a} \mid \text{!miR200c})) \mid (\text{SNAI1} \& \text{SNAI2} \& \text{NFkB} \& \\ &\text{!HNF1A}) = \end{aligned}$$

$$\begin{aligned} &((\text{SNAI1} \mid \text{SNAI2} \mid \text{Bcatenin} \mid \text{NFkB}) \& \text{!HNF1A} \& (\text{NANOG} \mid \text{cMyc} \mid \text{KLF4} \mid \text{!SOX2} \mid \text{ZEB1} \mid \\ &\text{SNAI2} \mid \text{!miR34a} \mid \text{!miR200c})) \mid (\text{SNAI1} \& \text{SNAI2} \& \text{NFkB} \& \text{!HNF1A}) \end{aligned}$$

Bcatenin = (EZH2 & BMI1 & !p53 & (!miR200ab | !SOX2)) | (TGFB & !p53 & !SOX2 & !miR200ab)

Bcatenin new function = (EZH2 & BMI1 & !p53 & (!((HNF4A | SOX2) & !ZEB1 & !SNAI2) | !SOX2)) | (TGFB & !p53 & !SOX2 & !((HNF4A | SOX2) & !ZEB1 & !SNAI2))

FOXA2 = ((HNF4A | HNF6) & (FOXA2 | SOX9 | Bcatenin) & !SOX2 & (!TGFB | !miR200ab)) | (HNF4A & (FOXA2 | HNF6) & !SOX2 & !TGFB)

FOXA2 new function = ((HNF4A | HNF6) & (FOXA2 | SOX9 | Bcatenin) & !SOX2 & (!TGFB | !((HNF4A | SOX2) & !ZEB1 & !SNAI2)))) | (HNF4A & (FOXA2 | HNF6) & !SOX2 & !TGFB)

Deleted node = miR34a

miR34a regulated nodes = SNAI1, cMyc, SNAI2, BMI1, E2F, CyclinD, ZEB1, SOX2, NANOG, NFkB, KLF4, p53

miR34a = (p53 | HNF4A) & !ZEB1 & !SNAI1

$$\text{SNAI1} = ((\text{TGFB} \mid \text{NFkB} \mid \text{cMyc} \mid \text{YAP1}) \& (!\text{SNAI1} \mid !\text{SNAI2} \mid \text{NANOG} \mid \text{cMyc} \mid \text{KLF4} \mid$$

$$!\text{SOX2}) \& !\text{miR34a} \& (!\text{HNF4A} \mid !\text{HNF1A})) \mid (\text{NFkB} \& \text{cMyc} \& !\text{miR34a} \& !\text{HNF4A} \&$$

$$!\text{HNF1A}) \mid (\text{TGFB} \& \text{NFkB} \& (\text{cMyc} \mid \text{YAP1})) \mid (\text{NFkB} \& !\text{HNF4A} \& !\text{HNF1A}) \mid ((\text{NANOG} \mid$$

$$\text{OCT4}) \& (!\text{HNF4A} \mid !\text{HNF1A}) \& (\text{YAP1} \mid \text{cMyc})) \mid (\text{NFkB} \& !\text{miR34a} \& !\text{HNF1A})$$

$$\text{SNAI1 new function} = ((\text{TGFB} \mid \text{NFkB} \mid \text{cMyc} \mid \text{YAP1}) \& (!\text{SNAI1} \mid !\text{SNAI2} \mid \text{NANOG} \mid \text{cMyc}$$

$$\mid \text{KLF4} \mid !\text{SOX2}) \& !((\text{p53} \mid \text{HNF4A}) \& !\text{ZEB1} \& !\text{SNAI1}) \& (!\text{HNF4A} \mid !\text{HNF1A})) \mid (\text{NFkB} \&$$

$$\text{cMyc} \& !((\text{p53} \mid \text{HNF4A}) \& !\text{ZEB1} \& !\text{SNAI1}) \& !\text{HNF4A} \& !\text{HNF1A}) \mid (\text{TGFB} \& \text{NFkB} \&$$

$$(\text{cMyc} \mid \text{YAP1})) \mid (\text{NFkB} \& !\text{HNF4A} \& !\text{HNF1A}) \mid ((\text{NANOG} \mid \text{OCT4}) \& (!\text{HNF4A} \mid !\text{HNF1A}) \&$$

$$(\text{YAP1} \mid \text{cMyc})) \mid (\text{NFkB} \& !((\text{p53} \mid \text{HNF4A}) \& !\text{ZEB1} \& !\text{SNAI1}) \& !\text{HNF1A}) = ((\text{TGFB} \mid$$

$$\text{NFkB} \mid \text{cMyc} \mid \text{YAP1}) \& (!\text{SNAI1} \mid !\text{SNAI2} \mid \text{NANOG} \mid \text{cMyc} \mid \text{KLF4} \mid !\text{SOX2}) \& ((\text{p53} \&$$

$$!\text{HNF4A}) \mid \text{ZEB1} \mid \text{SNAI1}) \& (!\text{HNF4A} \mid !\text{HNF1A})) \mid (\text{NFkB} \& \text{cMyc} \& ((\text{p53} \& !\text{HNF4A}) \mid$$

$$\text{ZEB1} \mid \text{SNAI1}) \& !\text{HNF4A} \& !\text{HNF1A}) \mid (\text{TGFB} \& \text{NFkB} \& (\text{cMyc} \mid \text{YAP1})) \mid (\text{NFkB} \&$$

$$!\text{HNF4A} \& !\text{HNF1A}) \mid ((\text{NANOG} \mid \text{OCT4}) \& (!\text{HNF4A} \mid !\text{HNF1A}) \& (\text{YAP1} \mid \text{cMyc})) \mid (\text{NFkB} \&$$

$$((\text{p53} \& !\text{HNF4A}) \mid \text{ZEB1} \mid \text{SNAI1}) \& !\text{HNF1A})$$

$$\text{cMyc} = (\text{E2F} \& (\text{NFkB} \mid \text{YAP1} \mid \text{Bcatenin} \mid \text{SOX2}) \& !\text{p53} \& (!\text{TGFB} \mid !\text{HNF4A} \mid !\text{miR34a})) \mid$$

$$((\text{YAP1} \mid \text{SOX2}) \& (\text{E2F} \mid \text{Bcatenin}) \& !\text{p53} \& (!\text{TGFB} \mid !\text{miR34a})) \mid (\text{NFkB} \& !\text{p53} \& (\text{YAP1} \mid$$

$$\text{E2F}))$$

$$\text{cMyc new function} = (\text{E2F} \& (\text{NFkB} \mid \text{YAP1} \mid \text{Bcatenin} \mid \text{SOX2}) \& !\text{p53} \& (!\text{TGFB} \mid !\text{HNF4A} \mid$$

$$!((\text{p53} \mid \text{HNF4A}) \& !\text{ZEB1} \& !\text{SNAI1}))) \mid ((\text{YAP1} \mid \text{SOX2}) \& (\text{E2F} \mid \text{Bcatenin}) \& !\text{p53} \&$$

$$(!\text{TGFB} \mid !((\text{p53} \mid \text{HNF4A}) \& !\text{ZEB1} \& !\text{SNAI1}))) \mid (\text{NFkB} \& !\text{p53} \& (\text{YAP1} \mid \text{E2F})) = (\text{E2F} \&$$

$$(\text{NFkB} \mid \text{YAP1} \mid \text{Bcatenin} \mid \text{SOX2}) \& !\text{p53} \& (!\text{TGFB} \mid !\text{HNF4A} \mid (!\text{p53} \& !\text{HNF4A}) \mid \text{ZEB1} \mid$$

$\text{SNAI1}) \mid ((\text{YAP1} \mid \text{SOX2}) \& (\text{E2F} \mid \text{Bcatenin}) \& \text{!p53} \& (\text{!TGFB} \mid (\text{!p53} \& \text{!HNF4A}) \mid \text{ZEB1} \mid \text{SNAI1})) \mid (\text{NFkB} \& \text{!p53} \& (\text{YAP1} \mid \text{E2F}))$

$\text{SNAI2} = ((\text{SOX9} \mid ((\text{SNAI1} \mid \text{NFkB}) \& \text{!miR34a}) \mid \text{NFkB} \mid \text{SNAI2}) \& \text{!HNF4A} \& (\text{!HNF1A} \mid \text{!FOXA2}) \& (\text{!KLF4} \mid \text{!SNAI1}) \& \text{!miR200c} \& ((\text{!HNF4A} \& \text{!SOX2}) \mid \text{ZEB1} \mid \text{SNAI2})) \mid ((\text{YAP1} \mid \text{Bcatenin}) \& (\text{NFkB} \mid \text{SNAI2}) \& (\text{!HNF4A} \mid \text{!HNF1A}) \& \text{!FOXA2} \& ((\text{!HNF4A} \& \text{!SOX2}) \mid \text{ZEB1} \mid \text{SNAI2}) \& \text{!miR200c}) \mid (\text{NANOG} \& (\text{YAP1} \mid \text{Bcatenin}) \& (((\text{SNAI1} \mid \text{NFkB}) \& \text{!miR34a}) \mid \text{SNAI2}) \& (\text{!HNF4A} \mid \text{!HNF1A}) \& ((\text{!HNF4A} \& \text{!SOX2}) \mid \text{ZEB1} \mid \text{SNAI2}) \& \text{!miR200c})$

$\text{SNAI2 new function} = ((\text{SOX9} \mid ((\text{SNAI1} \mid \text{NFkB}) \& \text{!((p53} \mid \text{HNF4A}) \& \text{!ZEB1} \& \text{!SNAI1)})) \mid \text{NFkB} \mid \text{SNAI2}) \& \text{!HNF4A} \& (\text{!HNF1A} \mid \text{!FOXA2}) \& (\text{!KLF4} \mid \text{!SNAI1}) \& \text{!miR200c} \& ((\text{!HNF4A} \& \text{!SOX2}) \mid \text{ZEB1} \mid \text{SNAI2})) \mid ((\text{YAP1} \mid \text{Bcatenin}) \& (\text{NFkB} \mid \text{SNAI2}) \& (\text{!HNF4A} \mid \text{!HNF1A}) \& \text{!FOXA2} \& ((\text{!HNF4A} \& \text{!SOX2}) \mid \text{ZEB1} \mid \text{SNAI2}) \& \text{!miR200c}) \mid (\text{NANOG} \& (\text{YAP1} \mid \text{Bcatenin}) \& (((\text{SNAI1} \mid \text{NFkB}) \& \text{!((p53} \mid \text{HNF4A}) \& \text{!ZEB1} \& \text{!SNAI1)})) \mid \text{SNAI2}) \& (\text{!HNF4A} \mid \text{!HNF1A}) \& ((\text{!HNF4A} \& \text{!SOX2}) \mid \text{ZEB1} \mid \text{SNAI2}) \& \text{!miR200c}) = ((\text{SOX9} \mid ((\text{SNAI1} \mid \text{NFkB}) \& ((\text{!p53} \& \text{!HNF4A}) \mid \text{ZEB1} \mid \text{SNAI1}))) \mid \text{NFkB} \mid \text{SNAI2}) \& \text{!HNF4A} \& (\text{!HNF1A} \mid \text{!FOXA2}) \& (\text{!KLF4} \mid \text{!SNAI1}) \& \text{!miR200c} \& ((\text{!HNF4A} \& \text{!SOX2}) \mid \text{ZEB1} \mid \text{SNAI2})) \mid ((\text{YAP1} \mid \text{Bcatenin}) \& (\text{NFkB} \mid \text{SNAI2}) \& (\text{!HNF4A} \mid \text{!HNF1A}) \& \text{!FOXA2} \& ((\text{!HNF4A} \& \text{!SOX2}) \mid \text{ZEB1} \mid \text{SNAI2}) \& \text{!miR200c}) \mid (\text{NANOG} \& (\text{YAP1} \mid \text{Bcatenin}) \& (((\text{SNAI1} \mid \text{NFkB}) \& ((\text{!p53} \& \text{!HNF4A}) \mid \text{ZEB1} \mid \text{SNAI1}))) \mid \text{SNAI2}) \& (\text{!HNF4A} \mid \text{!HNF1A}) \& ((\text{!HNF4A} \& \text{!SOX2}) \mid \text{ZEB1} \mid \text{SNAI2}) \& \text{!miR200c})$

BMI1 = ((E2F | cMyc) & (SOX9 | NANOG | ((SNAI1 | NFkB) & !miR34a)) & !miR200c) |
(E2F & cMyc) | (E2F & !miR200c)

BMI1 new function = ((E2F | cMyc) & (SOX9 | NANOG | ((SNAI1 | NFkB) & !(p53 |
HNF4A) & !ZEB1 & !SNAI1))) & !miR200c) | (E2F & cMyc) | (E2F & !miR200c) = ((E2F |
cMyc) & (SOX9 | NANOG | ((SNAI1 | NFkB) & !(p53 & !HNF4A) | ZEB1 | SNAI1))) &
!miR200c) | (E2F & cMyc) | (E2F & !miR200c) = ((E2F | cMyc) & (SOX9 | NANOG |
((SNAI1 | NFkB) & !(p53 & !HNF4A) | ZEB1 | SNAI1))) & !miR200c) | (E2F & cMyc) | (E2F
& !miR200c)

E2F = ((cMyc | E2F | YAP1) & !RB & !p21 & ((!SNAI1 & !NFkB) | miR34a | !HNF4A)) |
(cMyc & E2F & !RB) | (YAP1 & !p21)

E2F new function = ((cMyc | E2F | YAP1) & !RB & !p21 & ((!SNAI1 & !NFkB) | ((p53 |
HNF4A) & !ZEB1 & !SNAI1) | !HNF4A)) | (cMyc & E2F & !RB) | (YAP1 & !p21) = ((cMyc |
E2F | YAP1) & !RB & !p21 & ((!SNAI1 & !NFkB) | (p53 & !ZEB1 & !SNAI1) | (HNF4A &
!ZEB1 & !SNAI1) | !HNF4A)) | (cMyc & E2F & !RB) | (YAP1 & !p21) = (cMyc | E2F | YAP1)
& !RB & !p21 & ((!SNAI1 & !NFkB) | (p53 & !ZEB1 & !SNAI1) | (!ZEB1 & !SNAI1) |
!HNF4A)) | (cMyc & E2F & !RB) | (YAP1 & !p21) = (cMyc | E2F | YAP1) & !RB & !p21 &
((!SNAI1 & !NFkB) | (!ZEB1 & !SNAI1) | !HNF4A)) | (cMyc & E2F & !RB) | (YAP1 & !p21)

CyclinD = (E2F & (YAP1 | cMyc | NFkB | HNF6 | FOXA2 | Bcatenin) & (!SOX2 | !SNAI1 | !KLF4 | !miR34a) & !p16) | ((YAP1 | Bcatenin) & (cMyc | E2F) & !p16) | (YAP1 & Bcatenin & !p16)

CyclinD new function = (E2F & (YAP1 | cMyc | NFkB | HNF6 | FOXA2 | Bcatenin) & (!SOX2 | !SNAI1 | !KLF4 | !(p53 | HNF4A) & !ZEB1 & !SNAI1)) & !p16) | ((YAP1 | Bcatenin) & (cMyc | E2F) & !p16) | (YAP1 & Bcatenin & !p16) =

(E2F & (YAP1 | cMyc | NFkB | HNF6 | FOXA2 | Bcatenin) & (!SOX2 | !SNAI1 | !KLF4 | !(p53 | HNF4A) | ZEB1 | SNAI1)) & !p16) | ((YAP1 | Bcatenin) & (cMyc | E2F) & !p16) | (YAP1 & Bcatenin & !p16) =

(E2F & (YAP1 | cMyc | NFkB | HNF6 | FOXA2 | Bcatenin) & (!SOX2 | !SNAI1 | !KLF4 | !(p53 & !HNF4A) | ZEB1 | SNAI1) & !p16) | ((YAP1 | Bcatenin) & (cMyc | E2F) & !p16) | (YAP1 & Bcatenin & !p16) =

(E2F & (YAP1 | cMyc | NFkB | HNF6 | FOXA2 | Bcatenin) & !p16) | ((YAP1 | Bcatenin) & (cMyc | E2F) & !p16) | (YAP1 & Bcatenin & !p16)

ZEB1 = ((SNAI1 | SNAI2 | Bcatenin | NFkB) & !HNF1A & (NANOG | cMyc | KLF4 | !SOX2 | ZEB1 | SNAI2 | !miR34a | !miR200c)) | (SNAI1 & SNAI2 & NFkB & !HNF1A)

ZEB1 new function = ((SNAI1 | SNAI2 | Bcatenin | NFkB) & !HNF1A & (NANOG | cMyc | KLF4 | !SOX2 | ZEB1 | SNAI2 | !(p53 | HNF4A) & !ZEB1 & !SNAI1) | !miR200c)) | (SNAI1 & SNAI2 & NFkB & !HNF1A) =

((SNAI1 | SNAI2 | Bcatenin | NFkB) & !HNF1A & (NANOG | cMyc | KLF4 | !SOX2 | ZEB1 | SNAI2 | !(p53 | HNF4A) & !ZEB1 & !SNAI1) | !miR200c)) | (SNAI1 & SNAI2 & NFkB &

!HNF1A) = ((SNAI1 | SNAI2 | Bcatenin | NFkB) & !HNF1A & (NANOG | cMyc | KLF4 |
 !SOX2 | ZEB1 | SNAI2 | !(p53 | HNF4A) | ZEB1 | SNAI1 | !miR200c)) | (SNAI1 & SNAI2 &
 NFkB & !HNF1A) = ((SNAI1 | SNAI2 | Bcatenin | NFkB) & !HNF1A & (NANOG | cMyc |
 KLF4 | !SOX2 | ZEB1 | SNAI2 | !(p53 | HNF4A) | SNAI1 | !miR200c)) | (SNAI1 & SNAI2 &
 NFkB & !HNF1A)

SOX2 = ((OCT4 | NANOG) & (Bcatenin | YAP1) & !p53 & !RB & !p21 & !miR200c |
 !miR34a)) | (OCT4 & NANOG & (SOX2 | cMyc) & !RB & !p21 & !p53) | (OCT4 & NANOG &
 Bcatenin & !p21 & !p53) | (NANOG & SOX2 & cMyc & !p53 & !RB & !p21)

SOX2 new function = ((OCT4 | NANOG) & (Bcatenin | YAP1) & !p53 & !RB & !p21 &
 (!miR200c | !((p53 | HNF4A) & !ZEB1 & !SNAI1))) | (OCT4 & NANOG & (SOX2 | cMyc) &
 !RB & !p21 & !p53) | (OCT4 & NANOG & Bcatenin & !p21 & !p53) | (NANOG & SOX2 &
 cMyc & !p53 & !RB & !p21)

NANOG = ((SOX2 | OCT4) & (KLF4 | NANOG) & !SNAI1 & !p53) | (SOX2 & OCT4 &
 (NFkB | TGFB) & !p53) | (OCT4 & NANOG & NFkB & !miR34a & !p53) | (SOX2 & NANOG
 & NFkB & !miR34a & !p53) | (!SNAI1 & cMyc & !miR34a & !NANOG & !NFkB & !p53 &
 !KLF4 & !TGFB & SOX2 & OCT4)

NANOG new function = ((SOX2 | OCT4) & (KLF4 | NANOG) & !SNAI1 & !p53) | (SOX2 &
 OCT4 & (NFkB | TGFB) & !p53) | (OCT4 & NANOG & NFkB & !((p53 | HNF4A) & !ZEB1 &
 !SNAI1) & !p53) | (SOX2 & NANOG & NFkB & !((p53 | HNF4A) & !ZEB1 & !SNAI1) & !p53)

$$\begin{aligned}
 & | (!\text{SNAI1} \ \& \ \text{cMyc} \ \& \ !((\text{p53} \ | \ \text{HNF4A}) \ \& \ !\text{ZEB1} \ \& \ !\text{SNAI1}) \ \& \ !\text{NANOG} \ \& \ !\text{NFkB} \ \& \ !\text{p53} \ \& \\
 & !\text{KLF4} \ \& \ !\text{TGFB} \ \& \ \text{SOX2} \ \& \ \text{OCT4}) = ((\text{SOX2} \ | \ \text{OCT4}) \ \& \ (\text{KLF4} \ | \ \text{NANOG}) \ \& \ !\text{SNAI1} \ \& \ !\text{p53}) \\
 & | (\text{SOX2} \ \& \ \text{OCT4} \ \& \ (\text{NFkB} \ | \ \text{TGFB}) \ \& \ !\text{p53}) \ | \ (\text{OCT4} \ \& \ \text{NANOG} \ \& \ \text{NFkB} \ \& \ (!\text{p53} \ \& \\
 & !\text{HNF4A}) \ | \ \text{ZEB1} \ | \ \text{SNAI1}) \ \& \ !\text{p53}) \ | \ (\text{SOX2} \ \& \ \text{NANOG} \ \& \ \text{NFkB} \ \& \ (!\text{p53} \ \& \ !\text{HNF4A}) \ | \ \text{ZEB1} \ | \\
 & \text{SNAI1}) \ \& \ !\text{p53}) \ | \ (!\text{SNAI1} \ \& \ \text{cMyc} \ \& \ (\ !\text{p53} \ \& \ !\text{HNF4A}) \ | \ \text{ZEB1} \ | \ \text{SNAI1}) \ \& \ !\text{NANOG} \ \& \\
 & !\text{NFkB} \ \& \ !\text{p53} \ \& \ !\text{KLF4} \ \& \ !\text{TGFB} \ \& \ \text{SOX2} \ \& \ \text{OCT4})
 \end{aligned}$$

$$\begin{aligned}
 \text{NFkB} &= (!\text{NFkB} \ \& \ \text{TGFB}) \ | \ (\text{miR34a} \ \& \ !\text{FOXA2} \ \& \ \text{NFkB}) \ | \ \text{KLF4} \ | \ \text{YAP1} \ | \ !\text{HNF4A} \ | \ !\text{HNF1A} \ | \\
 & !\text{p53} \ | \ \text{SNAI1}
 \end{aligned}$$

$$\begin{aligned}
 \text{NFkB new function} &= (!\text{NFkB} \ \& \ \text{TGFB}) \ | \ (((\text{p53} \ | \ \text{HNF4A}) \ \& \ !\text{ZEB1} \ \& \ !\text{SNAI1}) \ \& \ !\text{FOXA2} \ \& \\
 & \text{NFkB}) \ | \ \text{KLF4} \ | \ \text{YAP1} \ | \ !\text{HNF4A} \ | \ !\text{HNF1A} \ | \ !\text{p53} \ | \ \text{SNAI1}
 \end{aligned}$$

$$\text{KLF4} = (\text{NANOG} \ | \ \text{p53}) \ \& \ !\text{SNAI1} \ \& \ (!\text{SOX9} \ | \ !\text{miR34a})$$

$$\begin{aligned}
 \text{KLF4 new function} &= (\text{NANOG} \ | \ \text{p53}) \ \& \ !\text{SNAI1} \ \& \ (!\text{SOX9} \ | \ !((\text{p53} \ | \ \text{HNF4A}) \ \& \ !\text{ZEB1} \ \& \\
 & !\text{SNAI1})) = (\text{NANOG} \ | \ \text{p53}) \ \& \ !\text{SNAI1} \ \& \ (!\text{SOX9} \ | \ (!(\text{p53} \ | \ \text{HNF4A}) \ | \ \text{ZEB1} \ | \ \text{SNAI1})) =
 \end{aligned}$$

$$\begin{aligned}
 & (\text{NANOG} \ | \ \text{p53}) \ \& \ !\text{SNAI1} \ \& \ (!\text{SOX9} \ | \ (!(\text{p53} \ \& \ !\text{HNF4A}) \ | \ \text{ZEB1} \ | \ \text{SNAI1})) = (\text{NANOG} \ | \ \text{p53}) \\
 & \ \& \ !\text{SNAI1} \ \& \ (!\text{SOX9} \ | \ (!(\text{p53} \ \& \ !\text{HNF4A}) \ | \ \text{ZEB1}))
 \end{aligned}$$

$p53 = ((KLF4 \mid HNF6 \mid p53) \& !(TGFB \mid NFkB) \mid p53 \mid p14 \mid p16)) \mid (NFkB \& !(TGFB \mid NFkB) \mid p53 \mid p14 \mid p16) \& !miR34a \& !OCT4$

$p53 \text{ new function} = ((KLF4 \mid HNF6 \mid p53) \& !(TGFB \mid NFkB) \mid p53 \mid p14 \mid p16)) \mid (NFkB \& !(TGFB \mid NFkB) \mid p53 \mid p14 \mid p16) \& !((p53 \mid HNF4A) \& !ZEB1 \& !SNAI1) \& !OCT4 =$
 $((KLF4 \mid HNF6 \mid p53) \& !(TGFB \mid NFkB) \mid p53 \mid p14 \mid p16)) \mid (NFkB \& !(TGFB \mid NFkB) \mid p53 \mid p14 \mid p16) \& ((!p53 \& !HNF4A) \mid ZEB1 \mid SNAI1) \& !OCT4 =$

$((KLF4 \mid HNF6 \mid p53) \& !(TGFB \mid NFkB) \mid p53 \mid p14 \mid p16)) \mid (NFkB \& (p53 \mid p14 \mid p16) \& ((!p53 \& !HNF4A) \mid ZEB1 \mid SNAI1) \& !OCT4) =$

$(p53 \mid ((KLF4 \mid HNF6) \& !(TGFB \mid NFkB) \mid p53 \mid p14 \mid p16))) \mid (NFkB \& (p53 \mid p14 \mid p16) \& ((!p53 \& !HNF4A) \mid ZEB1 \mid SNAI1) \& !OCT4)$

Deleted node = miR200c

miR200c regulated nodes = SNAI2, BMI1, ZEB1, SOX2

$miR200c = ((HNF4A \mid OCT4) \& !BMI1 \& !ZEB1 \& !SNAI1) \mid (p53 \& (HNF4A \mid OCT4) \& !BMI1 \& (!ZEB1 \mid !SNAI1))$

$SNAI2 = ((SOX9 \mid ((SNAI1 \mid NFkB) \& ((!p53 \& !HNF4A) \mid ZEB1 \mid SNAI1)) \mid NFkB \mid SNAI2) \& !HNF4A \& (!HNF1A \mid !FOXA2) \& (!KLF4 \mid !SNAI1) \& !miR200c \& ((!HNF4A \& !SOX2) \mid ZEB1 \mid SNAI2)) \mid ((YAP1 \mid Bcatenin) \& (NFkB \mid SNAI2) \& (!HNF4A \mid !HNF1A) \& !FOXA2 \& ((!HNF4A \& !SOX2) \mid ZEB1 \mid SNAI2) \& !miR200c) \mid (NANOG \& (YAP1 \mid Bcatenin) \&$

ZEB1 = ((SNAI1 | SNAI2 | Bcatenin | NFkB) & !HNF1A & (NANOG | cMyc | KLF4 | !SOX2 | ZEB1 | SNAI2 | !(p53 | HNF4A) | SNAI1 | !miR200c)) | (SNAI1 & SNAI2 & NFkB & !HNF1A)

ZEB1 new function = ((SNAI1 | SNAI2 | Bcatenin | NFkB) & !HNF1A & (NANOG | cMyc | KLF4 | !SOX2 | ZEB1 | SNAI2 | !(p53 | HNF4A) | SNAI1 | !(((HNF4A | OCT4) & !BMI1 & !ZEB1 & !SNAI1) | (p53 & (HNF4A | OCT4) & !BMI1 & (!ZEB1 | !SNAI1)))))) | (SNAI1 & SNAI2 & NFkB & !HNF1A) =

((SNAI1 | SNAI2 | Bcatenin | NFkB) & !HNF1A & (NANOG | cMyc | KLF4 | !SOX2 | ZEB1 | SNAI2 | !(p53 | HNF4A) | SNAI1 | (!HNF4A & !OCT4) | BMI1 | ((ZEB1 | SNAI1) & (!p53 | (ZEB1 & SNAI1)))) | (SNAI1 & SNAI2 & NFkB & !HNF1A) =

((SNAI1 | SNAI2 | Bcatenin | NFkB) & !HNF1A & (NANOG | cMyc | KLF4 | !SOX2 | ZEB1 | SNAI2 | !(p53 | HNF4A) | SNAI1 | (!HNF4A & !OCT4) | BMI1)) | (SNAI1 & SNAI2 & NFkB & !HNF1A)

SOX2 = ((OCT4 | NANOG) & (Bcatenin | YAP1) & !p53 & !RB & !p21 & !miR200c | !(p53 | HNF4A) & !ZEB1 & !SNAI1))) | (OCT4 & NANOG & (SOX2 | cMyc) & !RB & !p21 & !p53) | (OCT4 & NANOG & Bcatenin & !p21 & !p53) | (NANOG & SOX2 & cMyc & !p53 & !RB & !p21)

SOX2 new function = ((OCT4 | NANOG) & (Bcatenin | YAP1) & !p53 & !RB & !p21 & !(((HNF4A | OCT4) & !BMI1 & !ZEB1 & !SNAI1) | (p53 & (HNF4A | OCT4) & !BMI1 & (!ZEB1 | !SNAI1)))) | !((p53 | HNF4A) & !ZEB1 & !SNAI1))) | (OCT4 & NANOG & (SOX2 |

cMyc) & !RB & !p21 & !p53) | (OCT4 & NANOG & Bcatenin & !p21 & !p53) | (NANOG & SOX2 & cMyc & !p53 & !RB & !p21)

Deleted node = KLF4

KLF4 regulated nodes = SNAI2, ZEB1, SNAI1, p53, OCT4, NANOG, HNF4A, NFkB, TGFB, HNF6, p21, TELasa

KLF4 = (NANOG | p53) & !SNAI1 & (!SOX9 | ((!p53 & !HNF4A) | ZEB1)) = (NANOG | p53) & !SNAI1 & (!SOX9 | (!p53 & !HNF4A) | ZEB1)

SNAI2 = ((SOX9 | ((SNAI1 | NFkB) & ((!p53 & !HNF4A) | ZEB1 | SNAI1)) | NFkB | SNAI2) & !HNF4A & (!HNF1A | !FOXA2) & (!KLF4 | !SNAI1) & !(((HNF4A | OCT4) & !BMI1 & !ZEB1 & !SNAI1) | (p53 & (HNF4A | OCT4) & !BMI1 & (!ZEB1 | !SNAI1)))) & (!HNF4A & !SOX2) | ZEB1 | SNAI2)) | ((YAP1 | Bcatenin) & (NFkB | SNAI2) & (!HNF4A | !HNF1A) & !FOXA2 & (!HNF4A & !SOX2) | ZEB1 | SNAI2) & !(((HNF4A | OCT4) & !BMI1 & !ZEB1 & !SNAI1) | (p53 & (HNF4A | OCT4) & !BMI1 & (!ZEB1 | !SNAI1)))) | (NANOG & (YAP1 | Bcatenin) & (((SNAI1 | NFkB) & ((!p53 & !HNF4A) | ZEB1 | SNAI1)) | SNAI2) & (!HNF4A | !HNF1A) & (!HNF4A & !SOX2) | ZEB1 | SNAI2) & !(((HNF4A | OCT4) & !BMI1 & !ZEB1 & !SNAI1) | (p53 & (HNF4A | OCT4) & !BMI1 & (!ZEB1 | !SNAI1))))

SNAI2 new function = ((SOX9 | ((SNAI1 | NFkB) & ((!p53 & !HNF4A) | ZEB1 | SNAI1)) | NFkB | SNAI2) & !HNF4A & (!HNF1A | !FOXA2) & !((NANOG | p53) & !SNAI1 & (!SOX9 | (!p53 & !HNF4A) | ZEB1)) | !SNAI1) & !(((HNF4A | OCT4) & !BMI1 & !ZEB1 & !SNAI1) |

$(p53 \& (HNF4A \mid OCT4) \& !BMI1 \& (!ZEB1 \mid !SNAI1))) \& ((!HNF4A \& !SOX2) \mid ZEB1 \mid SNAI2)) \mid ((YAP1 \mid Bcatenin) \& (NFkB \mid SNAI2) \& (!HNF4A \mid !HNF1A) \& !FOXA2 \& ((!HNF4A \& !SOX2) \mid ZEB1 \mid SNAI2) \& !(((HNF4A \mid OCT4) \& !BMI1 \& !ZEB1 \& !SNAI1) \mid (p53 \& (HNF4A \mid OCT4) \& !BMI1 \& (!ZEB1 \mid !SNAI1)))) \mid (NANOG \& (YAP1 \mid Bcatenin) \& (((SNAI1 \mid NFkB) \& (!p53 \& !HNF4A) \mid ZEB1 \mid SNAI1)) \mid SNAI2) \& (!HNF4A \mid !HNF1A) \& ((!HNF4A \& !SOX2) \mid ZEB1 \mid SNAI2) \& !(((HNF4A \mid OCT4) \& !BMI1 \& !ZEB1 \& !SNAI1) \mid (p53 \& (HNF4A \mid OCT4) \& !BMI1 \& (!ZEB1 \mid !SNAI1))))$

$ZEB1 = ((SNAI1 \mid SNAI2 \mid Bcatenin \mid NFkB) \& !HNF1A \& (NANOG \mid cMyc \mid KLF4 \mid !SOX2 \mid ZEB1 \mid SNAI2 \mid !(p53 \mid HNF4A) \mid SNAI1 \mid (!HNF4A \& !OCT4) \mid BMI1)) \mid (SNAI1 \& SNAI2 \& NFkB \& !HNF1A)$

$ZEB1 \text{ new function} = ((SNAI1 \mid SNAI2 \mid Bcatenin \mid NFkB) \& !HNF1A \& (NANOG \mid cMyc \mid ((NANOG \mid p53) \& !SNAI1 \& (!SOX9 \mid (!p53 \& !HNF4A) \mid ZEB1))) \mid !SOX2 \mid ZEB1 \mid SNAI2 \mid !(p53 \mid HNF4A) \mid SNAI1 \mid (!HNF4A \& !OCT4) \mid BMI1)) \mid (SNAI1 \& SNAI2 \& NFkB \& !HNF1A) =$

$((SNAI1 \mid SNAI2 \mid Bcatenin \mid NFkB) \& !HNF1A \& (NANOG \mid cMyc \mid ((NANOG \mid p53) \& (!SOX9 \mid (!p53 \& !HNF4A) \mid ZEB1))) \mid !SOX2 \mid ZEB1 \mid SNAI2 \mid !(p53 \mid HNF4A) \mid SNAI1 \mid (!HNF4A \& !OCT4) \mid BMI1)) \mid (SNAI1 \& SNAI2 \& NFkB \& !HNF1A) =$

$((SNAI1 \mid SNAI2 \mid Bcatenin \mid NFkB) \& !HNF1A \& (NANOG \mid cMyc \mid (p53 \& (!SOX9 \mid (!p53 \& !HNF4A) \mid ZEB1))) \mid !SOX2 \mid ZEB1 \mid SNAI2 \mid !(p53 \mid HNF4A) \mid SNAI1 \mid (!HNF4A \& !OCT4) \mid BMI1)) \mid (SNAI1 \& SNAI2 \& NFkB \& !HNF1A) =$

$((\text{SNAI1} \mid \text{SNAI2} \mid \text{Bcatenin} \mid \text{NFkB}) \& \text{!HNF1A} \& (\text{NANOG} \mid \text{cMyc} \mid (\text{p53} \& \text{!SOX9} \mid \text{ZEB1}))) \mid \text{!SOX2} \mid \text{ZEB1} \mid \text{SNAI2} \mid \text{!}(\text{p53} \mid \text{HNF4A}) \mid \text{SNAI1} \mid (\text{!HNF4A} \& \text{!OCT4}) \mid \text{BMI1})) \mid (\text{SNAI1} \& \text{SNAI2} \& \text{NFkB} \& \text{!HNF1A}) =$

$((\text{SNAI1} \mid \text{SNAI2} \mid \text{Bcatenin} \mid \text{NFkB}) \& \text{!HNF1A} \& (\text{NANOG} \mid \text{cMyc} \mid (\text{p53} \& \text{!SOX9}) \mid \text{!SOX2} \mid \text{ZEB1} \mid \text{SNAI2} \mid \text{!}(\text{p53} \mid \text{HNF4A}) \mid \text{SNAI1} \mid (\text{!HNF4A} \& \text{!OCT4}) \mid \text{BMI1})) \mid (\text{SNAI1} \& \text{SNAI2} \& \text{NFkB} \& \text{!HNF1A})$

$\text{SNAI1} = ((\text{TGFB} \mid \text{NFkB} \mid \text{cMyc} \mid \text{YAP1}) \& \text{!SNAI1} \mid \text{!SNAI2} \mid \text{NANOG} \mid \text{cMyc} \mid \text{KLF4} \mid \text{!SOX2}) \& ((\text{!p53} \& \text{!HNF4A}) \mid \text{ZEB1} \mid \text{SNAI1}) \& (\text{!HNF4A} \mid \text{!HNF1A})) \mid (\text{NFkB} \& \text{cMyc} \& ((\text{!p53} \& \text{!HNF4A}) \mid \text{ZEB1} \mid \text{SNAI1}) \& \text{!HNF4A} \& \text{!HNF1A}) \mid (\text{TGFB} \& \text{NFkB} \& (\text{cMyc} \mid \text{YAP1})) \mid (\text{NFkB} \& \text{!HNF4A} \& \text{!HNF1A}) \mid ((\text{NANOG} \mid \text{OCT4}) \& (\text{!HNF4A} \mid \text{!HNF1A}) \& (\text{YAP1} \mid \text{cMyc})) \mid (\text{NFkB} \& ((\text{!p53} \& \text{!HNF4A}) \mid \text{ZEB1} \mid \text{SNAI1}) \& \text{!HNF1A}))$

$\text{SNAI1 new function} = ((\text{TGFB} \mid \text{NFkB} \mid \text{cMyc} \mid \text{YAP1}) \& \text{!SNAI1} \mid \text{!SNAI2} \mid \text{NANOG} \mid \text{cMyc} \mid ((\text{NANOG} \mid \text{p53}) \& \text{!SNAI1} \& \text{!SOX9} \mid \text{!}(\text{p53} \& \text{!HNF4A}) \mid \text{ZEB1})) \mid \text{!SOX2}) \& ((\text{!p53} \& \text{!HNF4A}) \mid \text{ZEB1} \mid \text{SNAI1}) \& (\text{!HNF4A} \mid \text{!HNF1A})) \mid (\text{NFkB} \& \text{cMyc} \& ((\text{!p53} \& \text{!HNF4A}) \mid \text{ZEB1} \mid \text{SNAI1}) \& \text{!HNF4A} \& \text{!HNF1A}) \mid (\text{TGFB} \& \text{NFkB} \& (\text{cMyc} \mid \text{YAP1})) \mid (\text{NFkB} \& \text{!HNF4A} \& \text{!HNF1A}) \mid ((\text{NANOG} \mid \text{OCT4}) \& (\text{!HNF4A} \mid \text{!HNF1A}) \& (\text{YAP1} \mid \text{cMyc})) \mid (\text{NFkB} \& ((\text{!p53} \& \text{!HNF4A}) \mid \text{ZEB1} \mid \text{SNAI1}) \& \text{!HNF1A})) =$

$((\text{TGFB} \mid \text{NFkB} \mid \text{cMyc} \mid \text{YAP1}) \& \text{!SNAI1} \mid \text{!SNAI2} \mid \text{NANOG} \mid \text{cMyc} \mid \text{!SOX2}) \& ((\text{!p53} \& \text{!HNF4A}) \mid \text{ZEB1} \mid \text{SNAI1}) \& (\text{!HNF4A} \mid \text{!HNF1A})) \mid (\text{NFkB} \& \text{cMyc} \& ((\text{!p53} \& \text{!HNF4A}) \mid \text{ZEB1} \mid \text{SNAI1}) \& \text{!HNF4A} \& \text{!HNF1A}) \mid (\text{TGFB} \& \text{NFkB} \& (\text{cMyc} \mid \text{YAP1})) \mid (\text{NFkB} \& \text{!HNF4A} \& \text{!HNF1A}) \mid ((\text{NANOG} \mid \text{OCT4}) \& (\text{!HNF4A} \mid \text{!HNF1A}) \& (\text{YAP1} \mid \text{cMyc})) \mid (\text{NFkB} \& ((\text{!p53} \& \text{!HNF4A}) \mid \text{ZEB1} \mid \text{SNAI1}) \& \text{!HNF1A}))$

$p53 = (p53 \mid ((KLF4 \mid HNF6) \& (!TGFB \mid NFkB) \mid p53 \mid p14 \mid p16))) \mid (NFkB \& (p53 \mid p14 \mid p16) \& (!p53 \& !HNF4A) \mid ZEB1 \mid SNAI1) \& !OCT4)$

$p53 \text{ new function} = (p53 \mid (((NANOG \mid p53) \& !SNAI1 \& (!SOX9 \mid (!p53 \& !HNF4A) \mid ZEB1)) \mid HNF6) \& (!TGFB \mid NFkB) \mid p53 \mid p14 \mid p16))) \mid (NFkB \& (p53 \mid p14 \mid p16) \& (!p53 \& !HNF4A) \mid ZEB1 \mid SNAI1) \& !OCT4)$

$OCT4 = (SOX2 \& NANOG \& !p53 \& !RB) \mid ((SOX2 \mid NANOG) \& (OCT4 \mid KLF4) \& YAP1 \& !p53)$

$OCT4 \text{ new function} = (SOX2 \& NANOG \& !p53 \& !RB) \mid ((SOX2 \mid NANOG) \& (OCT4 \mid ((NANOG \mid p53) \& !SNAI1 \& (!SOX9 \mid (!p53 \& !HNF4A) \mid ZEB1))) \& YAP1 \& !p53)$

$NANOG = ((SOX2 \mid OCT4) \& (KLF4 \mid NANOG) \& !SNAI1 \& !p53) \mid (SOX2 \& OCT4 \& (NFkB \mid TGFB) \& !p53) \mid (OCT4 \& NANOG \& NFkB \& (!p53 \& !HNF4A) \mid ZEB1 \mid SNAI1) \& !p53) \mid (SOX2 \& NANOG \& NFkB \& (!p53 \& !HNF4A) \mid ZEB1 \mid SNAI1) \& !p53) \mid (!SNAI1 \& cMyc \& (!p53 \& !HNF4A) \mid ZEB1 \mid SNAI1) \& !NANOG \& !NFkB \& !p53 \& !KLF4 \& !TGFB \& SOX2 \& OCT4)$

$NANOG \text{ new function} = ((SOX2 \mid OCT4) \& (((NANOG \mid p53) \& !SNAI1 \& (!SOX9 \mid (!p53 \& !HNF4A) \mid ZEB1)) \mid NANOG) \& !SNAI1 \& !p53) \mid (SOX2 \& OCT4 \& (NFkB \mid TGFB) \& !p53)$

| (OCT4 & NANOG & NFkB & ((!p53 & !HNF4A) | ZEB1 | SNAI1) & !p53) | (SOX2 & NANOG & NFkB & ((!p53 & !HNF4A) | ZEB1 | SNAI1) & !p53) | (!SNAI1 & cMyc & ((!p53 & !HNF4A) | ZEB1 | SNAI1) & !NANOG & !NFkB & !p53 & !((NANOG | p53) & !SNAI1 & (!SOX9 | (!p53 & !HNF4A) | ZEB1))) & !TGFB & SOX2 & OCT4) =

((SOX2 | OCT4) & ((p53 & !SNAI1 & (!SOX9 | (!p53 & !HNF4A) | ZEB1)) | NANOG) & !SNAI1 & !p53) | (SOX2 & OCT4 & (NFkB | TGFB) & !p53) | (OCT4 & NANOG & NFkB & ((!p53 & !HNF4A) | ZEB1 | SNAI1) & !p53) | (SOX2 & NANOG & NFkB & ((!p53 & !HNF4A) | ZEB1 | SNAI1) & !p53) | (!SNAI1 & cMyc & ((!p53 & !HNF4A) | ZEB1 | SNAI1) & !NANOG & !NFkB & !p53 & !((NANOG | p53) & !SNAI1 & (!SOX9 | (!p53 & !HNF4A) | ZEB1))) & !TGFB & SOX2 & OCT4) =

((SOX2 | OCT4) & ((p53 & !SNAI1 & (!SOX9 | ZEB1)) | NANOG) & !SNAI1 & !p53) | (SOX2 & OCT4 & (NFkB | TGFB) & !p53) | (OCT4 & NANOG & NFkB & ((!p53 & !HNF4A) | ZEB1 | SNAI1) & !p53) | (SOX2 & NANOG & NFkB & ((!p53 & !HNF4A) | ZEB1 | SNAI1) & !p53) | (!SNAI1 & cMyc & ((!p53 & !HNF4A) | ZEB1 | SNAI1) & !NANOG & !NFkB & !p53 & !((NANOG | p53) & !SNAI1 & (!SOX9 | (!p53 & !HNF4A) | ZEB1))) & !TGFB & SOX2 & OCT4) =

((SOX2 | OCT4) & NANOG & !SNAI1 & !p53) | (SOX2 & OCT4 & (NFkB | TGFB) & !p53) | (OCT4 & NANOG & NFkB & ((!p53 & !HNF4A) | ZEB1 | SNAI1) & !p53) | (SOX2 & NANOG & NFkB & ((!p53 & !HNF4A) | ZEB1 | SNAI1) & !p53) | (!SNAI1 & cMyc & ((!p53 & !HNF4A) | ZEB1 | SNAI1) & !NANOG & !NFkB & !p53 & !((NANOG | p53) & !SNAI1 & (!SOX9 | (!p53 & !HNF4A) | ZEB1))) & !TGFB & SOX2 & OCT4) =

((SOX2 | OCT4) & NANOG & !SNAI1 & !p53) | (SOX2 & OCT4 & (NFkB | TGFB) & !p53) | (OCT4 & NANOG & NFkB & ((!p53 & !HNF4A) | ZEB1 | SNAI1) & !p53) | (SOX2 & NANOG & NFkB & ((!p53 & !HNF4A) | ZEB1 | SNAI1) & !p53) | (!SNAI1 & cMyc & ((!p53 &

$$\begin{aligned} & \neg \text{HNF4A} \mid \text{ZEB1} \mid \text{SNAI1} \mid \neg \text{NANOG} \mid \neg \text{NFkB} \mid \text{p53} \mid ((\neg \text{NANOG} \mid \text{p53}) \mid \text{SNAI1} \mid \\ & \neg (\text{SOX9} \mid (\text{p53} \mid \neg \text{HNF4A}) \mid \text{ZEB1})) \mid \neg \text{TGFB} \mid \text{SOX2} \mid \text{OCT4} = \\ & = ((\text{SOX2} \mid \text{OCT4}) \mid \text{NANOG} \mid \neg \text{SNAI1} \mid \text{p53}) \mid (\text{SOX2} \mid \text{OCT4} \mid (\text{NFkB} \mid \text{TGFB}) \mid \\ & \text{p53}) \mid (\text{OCT4} \mid \text{NANOG} \mid \text{NFkB} \mid ((\text{p53} \mid \neg \text{HNF4A}) \mid \text{ZEB1} \mid \text{SNAI1}) \mid \text{p53}) \mid (\text{SOX2} \mid \\ & \text{NANOG} \mid \text{NFkB} \mid ((\text{p53} \mid \neg \text{HNF4A}) \mid \text{ZEB1} \mid \text{SNAI1}) \mid \text{p53}) \mid (\neg \text{SNAI1} \mid \text{cMyc} \mid (\neg \text{p53} \mid \\ & \neg \text{HNF4A}) \mid \text{ZEB1} \mid \text{SNAI1}) \mid \neg \text{NANOG} \mid \neg \text{NFkB} \mid \text{p53} \mid \neg \text{TGFB} \mid \text{SOX2} \mid \text{OCT4}) = \\ & ((\text{SOX2} \mid \text{OCT4}) \mid \text{NANOG} \mid \neg \text{SNAI1} \mid \text{p53}) \mid (\text{SOX2} \mid \text{OCT4} \mid (\text{NFkB} \mid \text{TGFB}) \mid \text{p53}) \mid \\ & (\text{OCT4} \mid \text{NANOG} \mid \text{NFkB} \mid (\neg \text{HNF4A} \mid \text{ZEB1} \mid \text{SNAI1}) \mid \text{p53}) \mid (\text{SOX2} \mid \text{NANOG} \mid \text{NFkB} \\ & \mid (\neg \text{HNF4A} \mid \text{ZEB1} \mid \text{SNAI1}) \mid \text{p53}) \mid (\neg \text{SNAI1} \mid \text{cMyc} \mid (\neg \text{HNF4A} \mid \text{ZEB1} \mid \text{SNAI1}) \mid \\ & \neg \text{NANOG} \mid \neg \text{NFkB} \mid \text{p53} \mid \neg \text{TGFB} \mid \text{SOX2} \mid \text{OCT4}) \end{aligned}$$

$$\begin{aligned} \text{HNF4A} = & ((\text{HNF1A} \mid \text{FOXA2} \mid (\neg \text{NANOG} \mid \neg \text{cMyc} \mid \neg \text{KLF4} \mid \text{SOX2}) \mid \text{HNF6} \mid \text{HNF4A}) \mid \\ & \neg \text{SNAI1} \mid \neg \text{SNAI2} \mid (\neg \text{NFkB} \mid \neg \text{YAP1} \mid \text{p53})) \mid (\text{HNF4A} \mid (\text{HNF1A} \mid \text{FOXA2} \mid \text{HNF6}) \mid \\ & (\neg \text{SNAI2} \mid \neg \text{SNAI1})) \mid (\text{FOXA2} \mid \neg \text{SNAI1} \mid \neg \text{YAP1} \mid \neg \text{SNAI2} \mid \text{p53}) \mid (\text{HNF1A} \mid (\text{HNF4A} \mid \\ & \text{FOXA2} \mid \text{HNF6}) \mid (\neg \text{SNAI2} \mid \neg \text{SNAI1}) \mid \neg \text{YAP1} \mid (\neg \text{NFkB} \mid \text{p53})) \end{aligned}$$

$$\begin{aligned} \text{HNF4A new function} = & ((\text{HNF1A} \mid \text{FOXA2} \mid (\neg \text{NANOG} \mid \neg \text{cMyc} \mid \neg (\text{NANOG} \mid \text{p53}) \mid \\ & \neg \text{SNAI1} \mid (\neg \text{SOX9} \mid (\text{p53} \mid \neg \text{HNF4A}) \mid \text{ZEB1})) \mid \text{SOX2}) \mid \text{HNF6} \mid \text{HNF4A}) \mid \neg \text{SNAI1} \mid \\ & \neg \text{SNAI2} \mid (\neg \text{NFkB} \mid \neg \text{YAP1} \mid \text{p53})) \mid (\text{HNF4A} \mid (\text{HNF1A} \mid \text{FOXA2} \mid \text{HNF6}) \mid (\neg \text{SNAI2} \mid \\ & \neg \text{SNAI1})) \mid (\text{FOXA2} \mid \neg \text{SNAI1} \mid \neg \text{YAP1} \mid \neg \text{SNAI2} \mid \text{p53}) \mid (\text{HNF1A} \mid (\text{HNF4A} \mid \text{FOXA2} \mid \\ & \text{HNF6}) \mid (\neg \text{SNAI2} \mid \neg \text{SNAI1}) \mid \neg \text{YAP1} \mid (\neg \text{NFkB} \mid \text{p53})) = \end{aligned}$$

$$\begin{aligned} & ((\text{HNF1A} \mid \text{FOXA2} \mid (\neg \text{NANOG} \mid \neg \text{cMyc} \mid \neg (\text{NANOG} \mid \text{p53}) \mid \text{SNAI1} \mid \neg (\text{SOX9} \mid (\text{p53} \mid \\ & \neg \text{HNF4A}) \mid \text{ZEB1})) \mid \text{SOX2}) \mid \text{HNF6} \mid \text{HNF4A}) \mid \neg \text{SNAI1} \mid \neg \text{SNAI2} \mid (\neg \text{NFkB} \mid \neg \text{YAP1} \mid \end{aligned}$$

!p53)) | (HNF4A & (HNF1A | FOXA2 | HNF6) & (!SNAI2 | !SNAI1)) | (FOXA2 & !SNAI1 & !YAP1 & !SNAI2 & !p53) | (HNF1A & (HNF4A | FOXA2 | HNF6) & (!SNAI2 | !SNAI1) & !YAP1 & (!NFkB | !p53)) =

((HNF1A | FOXA2 | (!NANOG & !cMyc & ((!NANOG & !p53) | SNAI1 | !(SOX9 | (!p53 & !HNF4A) | ZEB1)) & SOX2) | HNF6 | HNF4A) & !SNAI1 & !SNAI2 & (!NFkB | !YAP1 | !p53)) | (HNF4A & (HNF1A | FOXA2 | HNF6) & (!SNAI2 | !SNAI1)) | (FOXA2 & !SNAI1 & !YAP1 & !SNAI2 & !p53) | (HNF1A & (HNF4A | FOXA2 | HNF6) & (!SNAI2 | !SNAI1) & !YAP1 & (!NFkB | !p53))

NFkB = (!NFkB & TGFB) | ((p53 | HNF4A) & !ZEB1 & !SNAI1 & !FOXA2 & NFkB) | KLF4 | YAP1 | !HNF4A | !HNF1A | !p53 | SNAI1

NFkB new function = (!NFkB & TGFB) | ((p53 | HNF4A) & !ZEB1 & !SNAI1 & !FOXA2 & NFkB) | ((NANOG | p53) & !SNAI1 & (!SOX9 | (!p53 & !HNF4A) | ZEB1)) | YAP1 | !HNF4A | !HNF1A | !p53 | SNAI1 =

(!NFkB & TGFB) | ((p53 | HNF4A) & !ZEB1 & !SNAI1 & !FOXA2 & NFkB) | ((NANOG | p53) & (!SOX9 | (!p53 & !HNF4A) | ZEB1)) | YAP1 | !HNF4A | !HNF1A | !p53 | SNAI1=

(!NFkB & TGFB) | ((p53 | HNF4A) & !ZEB1 & !SNAI1 & !FOXA2 & NFkB) | (NANOG & (!SOX9 | (!p53 & !HNF4A) | ZEB1)) | (!SOX9 | ZEB1) | YAP1 | !HNF4A | !HNF1A | !p53 | SNAI1 = (!NFkB & TGFB) | ((p53 | HNF4A) & !ZEB1 & !SNAI1 & !FOXA2 & NFkB) | (NANOG & !SOX9) | (NANOG & !p53 & !HNF4A) | (NANOG & ZEB1) | (!SOX9 | ZEB1) | YAP1 | !HNF4A | !HNF1A | !p53 | SNAI1 = (!NFkB & TGFB) | ((p53 | HNF4A) & !ZEB1 & !SNAI1 & !FOXA2 & NFkB) | (NANOG & !SOX9) | (NANOG & ZEB1) | (!SOX9 | ZEB1) |

$$\begin{aligned} \text{YAP1} \mid \neg \text{HNF4A} \mid \neg \text{HNF1A} \mid \neg \text{p53} \mid \text{SNAI1} &= (\neg \text{NFkB} \ \& \ \text{TGFB}) \mid ((\text{p53} \mid \text{HNF4A}) \ \& \ \neg \text{ZEB1} \ \& \\ \neg \text{SNAI1} \ \& \ \neg \text{FOXA2} \ \& \ \text{NFkB}) \mid (\text{NANOG} \ \& \ (\neg \text{SOX9} \mid \text{ZEB1})) \mid (\neg \text{SOX9} \mid \text{ZEB1}) \mid \text{YAP1} \mid \\ \neg \text{HNF4A} \mid \neg \text{HNF1A} \mid \neg \text{p53} \mid \text{SNAI1} &= (\neg \text{NFkB} \ \& \ \text{TGFB}) \mid ((\text{p53} \mid \text{HNF4A}) \ \& \ \neg \text{ZEB1} \ \& \ \neg \text{SNAI1} \ \& \\ \neg \text{FOXA2} \ \& \ \text{NFkB}) \mid (\neg \text{SOX9} \mid \text{ZEB1}) \mid \text{YAP1} \mid \neg \text{HNF4A} \mid \neg \text{HNF1A} \mid \neg \text{p53} \mid \text{SNAI1} \end{aligned}$$

$$\text{TGFB} = (\text{NANOG} \mid \text{cMyc} \mid \neg \text{SOX2}) \ \& \ \neg \text{KLF4} \ \& \ \text{YAP1}$$

$$\begin{aligned} \text{TGFB new function} &= (\text{NANOG} \mid \text{cMyc} \mid \neg \text{SOX2}) \ \& \ \neg ((\text{NANOG} \mid \text{p53}) \ \& \ \neg \text{SNAI1} \ \& \ (\neg \text{SOX9} \mid \\ (\neg \text{p53} \ \& \ \neg \text{HNF4A}) \mid \text{ZEB1})) \ \& \ \text{YAP1} \end{aligned}$$

$$\begin{aligned} \text{HNF6} &= ((\text{HNF4A} \mid \text{HNF1A}) \ \& \ (\text{KLF4} \mid \text{HNF6} \mid \text{SOX9}) \ \& \ (\neg \text{OCT4} \mid \neg \text{SOX2} \mid \neg \text{NANOG})) \mid \\ (\neg \text{KLF4} \ \& \ \neg \text{NANOG} \ \& \ \neg \text{OCT4} \ \& \ \neg \text{SOX2} \ \& \ \neg \text{SOX9} \ \& \ \neg \text{HNF6} \ \& \ \neg \text{HNF4A} \ \& \ \text{HNF1A}) \mid (\neg \text{KLF4} \ \& \\ \neg \text{NANOG} \ \& \ \neg \text{OCT4} \ \& \ \neg \text{SOX2} \ \& \ \neg \text{SOX9} \ \& \ \neg \text{HNF6} \ \& \ \text{HNF4A}) \end{aligned}$$

$$\begin{aligned} \text{HNF6 new function} &= ((\text{HNF4A} \mid \text{HNF1A}) \ \& \ (((\text{NANOG} \mid \text{p53}) \ \& \ \neg \text{SNAI1} \ \& \ (\neg \text{SOX9} \mid (\neg \text{p53} \\ \ \& \ \neg \text{HNF4A}) \mid \text{ZEB1})) \mid \text{HNF6} \mid \text{SOX9}) \ \& \ (\neg \text{OCT4} \mid \neg \text{SOX2} \mid \neg \text{NANOG})) \mid (\neg ((\text{NANOG} \mid \text{p53}) \ \& \\ \neg \text{SNAI1} \ \& \ (\neg \text{SOX9} \mid (\neg \text{p53} \ \& \ \neg \text{HNF4A}) \mid \text{ZEB1})) \ \& \ \neg \text{NANOG} \ \& \ \neg \text{OCT4} \ \& \ \neg \text{SOX2} \ \& \ \neg \text{SOX9} \ \& \\ \neg \text{HNF6} \ \& \ \neg \text{HNF4A} \ \& \ \text{HNF1A}) \mid (\neg ((\text{NANOG} \mid \text{p53}) \ \& \ \neg \text{SNAI1} \ \& \ (\neg \text{SOX9} \mid (\neg \text{p53} \ \& \ \neg \text{HNF4A}) \mid \\ \text{ZEB1})) \ \& \ \neg \text{NANOG} \ \& \ \neg \text{OCT4} \ \& \ \neg \text{SOX2} \ \& \ \neg \text{SOX9} \ \& \ \neg \text{HNF6} \ \& \ \text{HNF4A})) = \end{aligned}$$

$$\begin{aligned} &((\text{HNF4A} \mid \text{HNF1A}) \ \& \ (((\text{NANOG} \mid \text{p53}) \ \& \ \neg \text{SNAI1}) \mid \text{HNF6} \mid \text{SOX9}) \ \& \ (\neg \text{OCT4} \mid \neg \text{SOX2} \mid \\ \neg \text{NANOG})) \mid (\neg ((\text{NANOG} \mid \text{p53}) \ \& \ \neg \text{SNAI1} \ \& \ (\neg \text{SOX9} \mid (\neg \text{p53} \ \& \ \neg \text{HNF4A}) \mid \text{ZEB1})) \ \& \ \neg \text{NANOG} \\ \ \& \ \neg \text{OCT4} \ \& \ \neg \text{SOX2} \ \& \ \neg \text{SOX9} \ \& \ \neg \text{HNF6} \ \& \ \neg \text{HNF4A} \ \& \ \text{HNF1A}) \mid (\neg ((\text{NANOG} \mid \text{p53}) \ \& \ \neg \text{SNAI1} \ \& \end{aligned}$$

(!SOX9 | (!p53 & !HNF4A) | ZEB1)) & !NANOG & !OCT4 & !SOX2 & !SOX9 & !HNF6 & HNF4A) =

((HNF4A | HNF1A) & (((NANOG | p53) & !SNAI1)| HNF6 | SOX9) & (!OCT4 | !SOX2 | !NANOG)) | (((!NANOG & !p53) | SNAI1 | (!SOX9 | (!p53 & !HNF4A) | ZEB1)) & !NANOG & !OCT4 & !SOX2 & !SOX9 & !HNF6 & !HNF4A & HNF1A) | (((!NANOG & !p53) | SNAI1 | (!SOX9 | (!p53 & !HNF4A) | ZEB1)) & !NANOG & !OCT4 & !SOX2 & !SOX9 & !HNF6 & HNF4A) =

((HNF4A | HNF1A) & (((NANOG | p53) & !SNAI1)| HNF6 | SOX9) & (!OCT4 | !SOX2 | !NANOG)) | (((!NANOG & !p53) | SNAI1 | (SOX9 & !(p53 & !HNF4A) & !ZEB1)) & !NANOG & !OCT4 & !SOX2 & !SOX9 & !HNF6 & !HNF4A & HNF1A) | (((!NANOG & !p53) | SNAI1 | (SOX9 & !(p53 & !HNF4A) & !ZEB1)) & !NANOG & !OCT4 & !SOX2 & !SOX9 & !HNF6 & HNF4A) =

((HNF4A | HNF1A) & (((NANOG | p53) & !SNAI1)| HNF6 | SOX9) & (!OCT4 | !SOX2 | !NANOG)) | (((!NANOG & !p53) | SNAI1) & !NANOG & !OCT4 & !SOX2 & !SOX9 & !HNF6 & !HNF4A & HNF1A) | (((!NANOG & !p53) | SNAI1) & !NANOG & !OCT4 & !SOX2 & !SOX9 & !HNF6 & HNF4A)

p21 = ((TGFB | HNF4A | SOX9 | FOXA2 | p53 | NFkB | KLF4) & !cMyc & !Bcatenin) | (p53 & (!cMyc | !Bcatenin))

p21 new function = ((TGFB | HNF4A | SOX9 | FOXA2 | p53 | NFkB | ((NANOG | p53) & !SNAI1 & (!SOX9 | (!p53 & !HNF4A) | ZEB1))) & !cMyc & !Bcatenin) | (p53 & (!cMyc | !Bcatenin)) = ((TGFB | HNF4A | SOX9 | FOXA2 | p53 | NFkB | (NANOG & !SNAI1 &

(YAP1 & (Bcatenin | cMyc | ZEB1 | ((NANOG | p53) & !SNAI1 & (!SOX9 | (!p53 & !HNF4A) | ZEB1))) & !p53 & E2F & (!RB | !TGFB | !SNAI1)) | (cMyc & E2F & ((NANOG | p53) & !SNAI1 & (!SOX9 | (!p53 & !HNF4A) | ZEB1)) & !TGFB)

Deleted node = cMyc

cMyc regulated nodes = E2F, BMI1, SNAI1, ZEB1, NANOG, EZH2, p14, p21, p16, HNF4A, TGFB, CyclinD, SOX2, TELasa

cMyc = (E2F & (NFkB | YAP1 | Bcatenin | SOX2) & !p53 & (!TGFB | !HNF4A | (!p53 & !HNF4A) | ZEB1 | SNAI1)) | ((YAP1 | SOX2) & (E2F | Bcatenin) & !p53 & (!TGFB | (!p53 & !HNF4A) | ZEB1 | SNAI1)) | (NFkB & !p53 & (YAP1 | E2F))

E2F = (cMyc | E2F | YAP1) & !RB & !p21 & ((!SNAI1 & !NFkB) | (!ZEB1 & !SNAI1) | !HNF4A) | (cMyc & E2F & !RB) | (YAP1 & !p21)

E2F new function = (((E2F & (NFkB | YAP1 | Bcatenin | SOX2) & !p53 & (!TGFB | !HNF4A | (!p53 & !HNF4A) | ZEB1 | SNAI1)) | ((YAP1 | SOX2) & (E2F | Bcatenin) & !p53 & (!TGFB | (!p53 & !HNF4A) | ZEB1 | SNAI1)) | (NFkB & !p53 & (YAP1 | E2F))) | E2F | YAP1) & !RB & !p21 & ((!SNAI1 & !NFkB) | (!ZEB1 & !SNAI1) | !HNF4A) | (((E2F & (NFkB | YAP1 | Bcatenin | SOX2) & !p53 & (!TGFB | !HNF4A | (!p53 & !HNF4A) | ZEB1 | SNAI1)) | ((YAP1 | SOX2) & (E2F | Bcatenin) & !p53 & (!TGFB | (!p53 & !HNF4A) | ZEB1 | SNAI1)) | (NFkB & !p53 & (YAP1 | E2F))) & E2F & !RB) | (YAP1 & !p21) = (((((YAP1 | SOX2) & (E2F | Bcatenin) & !p53 & (!TGFB | (!p53 & !HNF4A) | ZEB1 | SNAI1)) | (NFkB & !p53 & (YAP1 | E2F))) | E2F | YAP1) & !RB & !p21 & ((!SNAI1 & !NFkB) | (!ZEB1 & !SNAI1) | !HNF4A) | (((E2F & (NFkB | YAP1 | Bcatenin | SOX2) & !p53 & (!TGFB | !HNF4A | (!p53 & !HNF4A) |

$$\begin{aligned} & \text{ZEB1} \mid \text{SNAI1})) \mid ((\text{YAP1} \mid \text{SOX2}) \& (\text{E2F} \mid \text{Bcatenin}) \& !\text{p53} \& (!\text{TGFB} \mid (!\text{p53} \& !\text{HNF4A}) \mid \\ & \text{ZEB1} \mid \text{SNAI1})) \mid (\text{NFkB} \& !\text{p53} \& (\text{YAP1} \mid \text{E2F}))) \& \text{E2F} \& !\text{RB}) \mid (\text{YAP1} \& !\text{p21}) \end{aligned}$$

$$\begin{aligned} \text{BMI1} = & ((\text{E2F} \mid \text{cMyc}) \& (\text{SOX9} \mid \text{NANOG} \mid ((\text{SNAI1} \mid \text{NFkB}) \& (!\text{p53} \& !\text{HNF4A}) \mid \text{ZEB1} \mid \\ & \text{SNAI1}))) \& !(((\text{HNF4A} \mid \text{OCT4}) \& !\text{BMI1} \& !\text{ZEB1} \& !\text{SNAI1}) \mid (\text{p53} \& (\text{HNF4A} \mid \text{OCT4}) \& \\ & !\text{BMI1} \& (!\text{ZEB1} \mid !\text{SNAI1})))) \mid (\text{E2F} \& \text{cMyc}) \mid (\text{E2F} \& !(((\text{HNF4A} \mid \text{OCT4}) \& !\text{BMI1} \& !\text{ZEB1} \\ & \& !\text{SNAI1}) \mid (\text{p53} \& (\text{HNF4A} \mid \text{OCT4}) \& !\text{BMI1} \& (!\text{ZEB1} \mid !\text{SNAI1})))) \end{aligned}$$

$$\begin{aligned} \text{BMI1 new function} = & ((\text{E2F} \mid ((\text{E2F} \& (\text{NFkB} \mid \text{YAP1} \mid \text{Bcatenin} \mid \text{SOX2}) \& !\text{p53} \& (!\text{TGFB} \mid \\ & !\text{HNF4A} \mid (!\text{p53} \& !\text{HNF4A}) \mid \text{ZEB1} \mid \text{SNAI1})) \mid ((\text{YAP1} \mid \text{SOX2}) \& (\text{E2F} \mid \text{Bcatenin}) \& !\text{p53} \& \\ & (!\text{TGFB} \mid (!\text{p53} \& !\text{HNF4A}) \mid \text{ZEB1} \mid \text{SNAI1})) \mid (\text{NFkB} \& !\text{p53} \& (\text{YAP1} \mid \text{E2F})))) \& (\text{SOX9} \mid \\ & \text{NANOG} \mid ((\text{SNAI1} \mid \text{NFkB}) \& (!\text{p53} \& !\text{HNF4A}) \mid \text{ZEB1} \mid \text{SNAI1}))) \& !(((\text{HNF4A} \mid \text{OCT4}) \& \\ & !\text{BMI1} \& !\text{ZEB1} \& !\text{SNAI1}) \mid (\text{p53} \& (\text{HNF4A} \mid \text{OCT4}) \& !\text{BMI1} \& (!\text{ZEB1} \mid !\text{SNAI1})))) \mid (\text{E2F} \\ & \& ((\text{E2F} \& (\text{NFkB} \mid \text{YAP1} \mid \text{Bcatenin} \mid \text{SOX2}) \& !\text{p53} \& (!\text{TGFB} \mid !\text{HNF4A} \mid (!\text{p53} \& !\text{HNF4A}) \\ & \mid \text{ZEB1} \mid \text{SNAI1})) \mid ((\text{YAP1} \mid \text{SOX2}) \& (\text{E2F} \mid \text{Bcatenin}) \& !\text{p53} \& (!\text{TGFB} \mid (!\text{p53} \& !\text{HNF4A}) \mid \\ & \text{ZEB1} \mid \text{SNAI1})) \mid (\text{NFkB} \& !\text{p53} \& (\text{YAP1} \mid \text{E2F})))) \mid (\text{E2F} \& !(((\text{HNF4A} \mid \text{OCT4}) \& !\text{BMI1} \& \\ & !\text{ZEB1} \& !\text{SNAI1}) \mid (\text{p53} \& (\text{HNF4A} \mid \text{OCT4}) \& !\text{BMI1} \& (!\text{ZEB1} \mid !\text{SNAI1})))) = \end{aligned}$$

$$\begin{aligned} & ((\text{E2F} \mid (((\text{YAP1} \mid \text{SOX2}) \& (\text{E2F} \mid \text{Bcatenin}) \& !\text{p53} \& (!\text{TGFB} \mid (!\text{p53} \& !\text{HNF4A}) \mid \text{ZEB1} \mid \\ & \text{SNAI1})) \mid (\text{NFkB} \& !\text{p53} \& (\text{YAP1} \mid \text{E2F})))) \& (\text{SOX9} \mid \text{NANOG} \mid ((\text{SNAI1} \mid \text{NFkB}) \& (!\text{p53} \& \\ & !\text{HNF4A}) \mid \text{ZEB1} \mid \text{SNAI1}))) \& !(((\text{HNF4A} \mid \text{OCT4}) \& !\text{BMI1} \& !\text{ZEB1} \& !\text{SNAI1}) \mid (\text{p53} \& \\ & (\text{HNF4A} \mid \text{OCT4}) \& !\text{BMI1} \& (!\text{ZEB1} \mid !\text{SNAI1})))) \mid (\text{E2F} \& ((\text{E2F} \& (\text{NFkB} \mid \text{YAP1} \mid \text{Bcatenin} \\ & \mid \text{SOX2}) \& !\text{p53} \& (!\text{TGFB} \mid !\text{HNF4A} \mid (!\text{p53} \& !\text{HNF4A}) \mid \text{ZEB1} \mid \text{SNAI1})) \mid ((\text{YAP1} \mid \text{SOX2}) \\ & \& (\text{E2F} \mid \text{Bcatenin}) \& !\text{p53} \& (!\text{TGFB} \mid (!\text{p53} \& !\text{HNF4A}) \mid \text{ZEB1} \mid \text{SNAI1})) \mid (\text{NFkB} \& !\text{p53} \& \end{aligned}$$

$((YAP1 \mid E2F))) \mid (E2F \ \& \ !(((HNF4A \mid OCT4) \ \& \ !BMI1 \ \& \ !ZEB1 \ \& \ !SNAI1) \mid (p53 \ \& \ (HNF4A \mid OCT4) \ \& \ !BMI1 \ \& \ (!ZEB1 \mid !SNAI1))))$

$SNAI1 = ((TGFB \mid NFkB \mid cMyc \mid YAP1) \ \& \ (!SNAI1 \mid !SNAI2 \mid NANOG \mid cMyc \mid !SOX2) \ \& \ ((!p53 \ \& \ !HNF4A) \mid ZEB1 \mid SNAI1) \ \& \ (!HNF4A \mid !HNF1A)) \mid (NFkB \ \& \ cMyc \ \& \ (!p53 \ \& \ !HNF4A) \mid ZEB1 \mid SNAI1) \ \& \ !HNF4A \ \& \ !HNF1A) \mid (TGFB \ \& \ NFkB \ \& \ (cMyc \mid YAP1)) \mid (NFkB \ \& \ !HNF4A \ \& \ !HNF1A) \mid ((NANOG \mid OCT4) \ \& \ (!HNF4A \mid !HNF1A) \ \& \ (YAP1 \mid cMyc)) \mid (NFkB \ \& \ (!p53 \ \& \ !HNF4A) \mid ZEB1 \mid SNAI1) \ \& \ !HNF1A)$

$SNAI1 \text{ new function} = ((TGFB \mid NFkB \mid ((E2F \ \& \ (NFkB \mid YAP1 \mid Bcatenin \mid SOX2) \ \& \ !p53 \ \& \ (!TGFB \mid !HNF4A \mid (!p53 \ \& \ !HNF4A) \mid ZEB1 \mid SNAI1)) \mid ((YAP1 \mid SOX2) \ \& \ (E2F \mid Bcatenin) \ \& \ !p53 \ \& \ (!TGFB \mid (!p53 \ \& \ !HNF4A) \mid ZEB1 \mid SNAI1)) \mid (NFkB \ \& \ !p53 \ \& \ (YAP1 \mid E2F))) \mid YAP1) \ \& \ (!SNAI1 \mid !SNAI2 \mid NANOG \mid ((E2F \ \& \ (NFkB \mid YAP1 \mid Bcatenin \mid SOX2) \ \& \ !p53 \ \& \ (!TGFB \mid !HNF4A \mid (!p53 \ \& \ !HNF4A) \mid ZEB1 \mid SNAI1)) \mid ((YAP1 \mid SOX2) \ \& \ (E2F \mid Bcatenin) \ \& \ !p53 \ \& \ (!TGFB \mid (!p53 \ \& \ !HNF4A) \mid ZEB1 \mid SNAI1)) \mid (NFkB \ \& \ !p53 \ \& \ (YAP1 \mid E2F))) \mid !SOX2) \ \& \ ((!p53 \ \& \ !HNF4A) \mid ZEB1 \mid SNAI1) \ \& \ (!HNF4A \mid !HNF1A)) \mid (NFkB \ \& \ ((E2F \ \& \ (NFkB \mid YAP1 \mid Bcatenin \mid SOX2) \ \& \ !p53 \ \& \ (!TGFB \mid !HNF4A \mid (!p53 \ \& \ !HNF4A) \mid ZEB1 \mid SNAI1)) \mid ((YAP1 \mid SOX2) \ \& \ (E2F \mid Bcatenin) \ \& \ !p53 \ \& \ (!TGFB \mid (!p53 \ \& \ !HNF4A) \mid ZEB1 \mid SNAI1)) \mid (NFkB \ \& \ !p53 \ \& \ (YAP1 \mid E2F))) \ \& \ (!p53 \ \& \ !HNF4A) \mid ZEB1 \mid SNAI1) \ \& \ !HNF4A \ \& \ !HNF1A) \mid (TGFB \ \& \ NFkB \ \& \ (((E2F \ \& \ (NFkB \mid YAP1 \mid Bcatenin \mid SOX2) \ \& \ !p53 \ \& \ (!TGFB \mid !HNF4A \mid (!p53 \ \& \ !HNF4A) \mid ZEB1 \mid SNAI1)) \mid ((YAP1 \mid SOX2) \ \& \ (E2F \mid Bcatenin) \ \& \ !p53 \ \& \ (!TGFB \mid (!p53 \ \& \ !HNF4A) \mid ZEB1 \mid SNAI1)) \mid (NFkB \ \& \ !p53 \ \& \ (YAP1 \mid E2F))) \mid YAP1)) \mid (NFkB \ \& \ !HNF4A \ \& \ !HNF1A) \mid ((NANOG \mid OCT4) \ \& \ (!HNF4A \mid !HNF1A) \ \&$

$(YAP1 \mid ((E2F \ \& \ (NF\kappa B \mid YAP1 \mid Bcatenin \mid SOX2) \ \& \ !p53 \ \& \ (!TGFB \mid !HNF4A \mid (!p53 \ \& \ !HNF4A) \mid ZEB1 \mid SNAI1))) \mid ((YAP1 \mid SOX2) \ \& \ (E2F \mid Bcatenin) \ \& \ !p53 \ \& \ (!TGFB \mid (!p53 \ \& \ !HNF4A) \mid ZEB1 \mid SNAI1))) \mid (NF\kappa B \ \& \ !p53 \ \& \ (YAP1 \mid E2F)))))) \mid (NF\kappa B \ \& \ (!p53 \ \& \ !HNF4A) \mid ZEB1 \mid SNAI1) \ \& \ !HNF1A)$

$ZEB1 = ((SNAI1 \mid SNAI2 \mid Bcatenin \mid NF\kappa B) \ \& \ !HNF1A \ \& \ (NANOG \mid cMyc \mid (p53 \ \& \ !SOX9) \mid !SOX2 \mid ZEB1 \mid SNAI2 \mid !(p53 \mid HNF4A) \mid SNAI1 \mid (!HNF4A \ \& \ !OCT4) \mid BMI1))) \mid (SNAI1 \ \& \ SNAI2 \ \& \ NF\kappa B \ \& \ !HNF1A)$

$ZEB1 \text{ new function} = ((SNAI1 \mid SNAI2 \mid Bcatenin \mid NF\kappa B) \ \& \ !HNF1A \ \& \ (NANOG \mid ((E2F \ \& \ (NF\kappa B \mid YAP1 \mid Bcatenin \mid SOX2) \ \& \ !p53 \ \& \ (!TGFB \mid !HNF4A \mid (!p53 \ \& \ !HNF4A) \mid ZEB1 \mid SNAI1))) \mid ((YAP1 \mid SOX2) \ \& \ (E2F \mid Bcatenin) \ \& \ !p53 \ \& \ (!TGFB \mid (!p53 \ \& \ !HNF4A) \mid ZEB1 \mid SNAI1))) \mid (NF\kappa B \ \& \ !p53 \ \& \ (YAP1 \mid E2F)))) \mid (p53 \ \& \ !SOX9) \mid !SOX2 \mid ZEB1 \mid SNAI2 \mid !(p53 \mid HNF4A) \mid SNAI1 \mid (!HNF4A \ \& \ !OCT4) \mid BMI1))) \mid (SNAI1 \ \& \ SNAI2 \ \& \ NF\kappa B \ \& \ !HNF1A)$

$NANOG = ((SOX2 \mid OCT4) \ \& \ NANOG \ \& \ !SNAI1 \ \& \ !p53) \mid (SOX2 \ \& \ OCT4 \ \& \ (NF\kappa B \mid TGFB) \ \& \ !p53) \mid (OCT4 \ \& \ NANOG \ \& \ NF\kappa B \ \& \ (!HNF4A \mid ZEB1 \mid SNAI1) \ \& \ !p53) \mid (SOX2 \ \& \ NANOG \ \& \ NF\kappa B \ \& \ (!HNF4A \mid ZEB1 \mid SNAI1) \ \& \ !p53) \mid (!SNAI1 \ \& \ cMyc \ \& \ (!HNF4A \mid ZEB1 \mid SNAI1) \ \& \ !NANOG \ \& \ !NF\kappa B \ \& \ !p53 \ \& \ !TGFB \ \& \ SOX2 \ \& \ OCT4)$

$NANOG \text{ new function} = ((SOX2 \mid OCT4) \ \& \ NANOG \ \& \ !SNAI1 \ \& \ !p53) \mid (SOX2 \ \& \ OCT4 \ \& \ (NF\kappa B \mid TGFB) \ \& \ !p53) \mid (OCT4 \ \& \ NANOG \ \& \ NF\kappa B \ \& \ (!HNF4A \mid ZEB1 \mid SNAI1) \ \& \ !p53) \mid (SOX2 \ \& \ NANOG \ \& \ NF\kappa B \ \& \ (!HNF4A \mid ZEB1 \mid SNAI1) \ \& \ !p53) \mid (!SNAI1 \ \& \ ((E2F \ \& \ (NF\kappa B$

| YAP1 | Bcatenin | SOX2) & !p53 & (!TGFB | !HNF4A | (!p53 & !HNF4A) | ZEB1 | SNAI1)) |
 ((YAP1 | SOX2) & (E2F | Bcatenin) & !p53 & (!TGFB | (!p53 & !HNF4A) | ZEB1 | SNAI1)) |
 (NFkB & !p53 & (YAP1 | E2F))) & (!HNF4A | ZEB1 | SNAI1) & !NANOG & !NFkB & !p53 &
 !TGFB & SOX2 & OCT4) =

((SOX2 | OCT4) & NANOG & !SNAI1 & !p53) | (SOX2 & OCT4 & (NFkB | TGFB) & !p53) |
 (OCT4 & NANOG & NFkB & (!HNF4A | ZEB1 | SNAI1) & !p53) | (SOX2 & NANOG & NFkB
 & (!HNF4A | ZEB1 | SNAI1) & !p53) | (!SNAI1 & ((E2F & (NFkB | YAP1 | Bcatenin | SOX2)
 & !p53 & (!TGFB | !HNF4A | ZEB1 | SNAI1)) | ((YAP1 | SOX2) & (E2F | Bcatenin) & !p53 &
 (!TGFB | !HNF4A | ZEB1 | SNAI1)) | (NFkB & !p53 & (YAP1 | E2F))) & (!HNF4A | ZEB1 |
 SNAI1) & !NANOG & !NFkB & !p53 & !TGFB & SOX2 & OCT4) =

((SOX2 | OCT4) & NANOG & !SNAI1 & !p53) | (SOX2 & OCT4 & (NFkB | TGFB) & !p53) |
 (OCT4 & NANOG & NFkB & (!HNF4A | ZEB1 | SNAI1) & !p53) | (SOX2 & NANOG & NFkB
 & (!HNF4A | ZEB1 | SNAI1) & !p53) | (!SNAI1 & (!HNF4A | ZEB1 | SNAI1) & !NANOG &
 !NFkB & !p53 & !TGFB & SOX2 & OCT4 & ((E2F & (NFkB | YAP1 | Bcatenin | SOX2) &
 !p53 & (!TGFB | !HNF4A | ZEB1 | SNAI1)) | ((YAP1 | SOX2) & (E2F | Bcatenin) & !p53 &
 (!TGFB | !HNF4A | ZEB1 | SNAI1)) | (NFkB & !p53 & (YAP1 | E2F)))) =

((SOX2 | OCT4) & NANOG & !SNAI1 & !p53) | (SOX2 & OCT4 & (NFkB | TGFB) & !p53) |
 (OCT4 & NANOG & NFkB & (!HNF4A | ZEB1 | SNAI1) & !p53) | (SOX2 & NANOG & NFkB
 & (!HNF4A | ZEB1 | SNAI1) & !p53) | (!SNAI1 & (!HNF4A | ZEB1) & !NANOG & !NFkB &
 !p53 & !TGFB & SOX2 & OCT4 & ((E2F & (NFkB | YAP1 | Bcatenin | SOX2) & (!TGFB |
 !HNF4A | ZEB1 | SNAI1)) | ((YAP1 | SOX2) & (E2F | Bcatenin) & (!TGFB | !HNF4A | ZEB1
 | SNAI1)) | (NFkB & (YAP1 | E2F)))) =

((SOX2 | OCT4) & NANOG & !SNAI1 & !p53) | (SOX2 & OCT4 & (NFkB | TGFB) & !p53) |
 (OCT4 & NANOG & NFkB & (!HNF4A | ZEB1 | SNAI1) & !p53) | (SOX2 & NANOG & NFkB

$$\& (!\text{HNF4A} \mid \text{ZEB1} \mid \text{SNAI1}) \& !\text{p53}) \mid (!\text{SNAI1} \& (!\text{HNF4A} \mid \text{ZEB1}) \& !\text{NANOG} \& !\text{NFkB} \& !\text{p53} \& !\text{TGFB} \& \text{SOX2} \& \text{OCT4} \& (\text{E2F} \mid ((\text{YAP1} \mid \text{SOX2}) \& (\text{E2F} \mid \text{Bcatenin}) \& (!\text{TGFB} \mid !\text{HNF4A} \mid \text{ZEB1} \mid \text{SNAI1}))) \mid (\text{NFkB} \& (\text{YAP1} \mid \text{E2F})))) =$$

$$((\text{SOX2} \mid \text{OCT4}) \& \text{NANOG} \& !\text{SNAI1} \& !\text{p53}) \mid (\text{SOX2} \& \text{OCT4} \& (\text{NFkB} \mid \text{TGFB}) \& !\text{p53}) \mid (\text{OCT4} \& \text{NANOG} \& \text{NFkB} \& (!\text{HNF4A} \mid \text{ZEB1} \mid \text{SNAI1}) \& !\text{p53}) \mid (\text{SOX2} \& \text{NANOG} \& \text{NFkB} \& (!\text{HNF4A} \mid \text{ZEB1} \mid \text{SNAI1}) \& !\text{p53}) \mid (!\text{SNAI1} \& (!\text{HNF4A} \mid \text{ZEB1}) \& !\text{NANOG} \& !\text{NFkB} \& !\text{p53} \& !\text{TGFB} \& \text{SOX2} \& \text{OCT4} \& (\text{E2F} \mid ((\text{YAP1} \mid \text{SOX2}) \& (\text{E2F} \mid \text{Bcatenin})))) =$$

$$((\text{SOX2} \mid \text{OCT4}) \& \text{NANOG} \& !\text{SNAI1} \& !\text{p53}) \mid (\text{SOX2} \& \text{OCT4} \& (\text{NFkB} \mid \text{TGFB}) \& !\text{p53}) \mid (\text{OCT4} \& \text{NANOG} \& \text{NFkB} \& (!\text{HNF4A} \mid \text{ZEB1} \mid \text{SNAI1}) \& !\text{p53}) \mid (\text{SOX2} \& \text{NANOG} \& \text{NFkB} \& (!\text{HNF4A} \mid \text{ZEB1} \mid \text{SNAI1}) \& !\text{p53}) \mid (!\text{SNAI1} \& (!\text{HNF4A} \mid \text{ZEB1}) \& !\text{NANOG} \& !\text{NFkB} \& !\text{p53} \& !\text{TGFB} \& \text{SOX2} \& \text{OCT4} \& (\text{E2F} \mid ((\text{YAP1} \mid \text{SOX2}) \& \text{Bcatenin})))) =$$

$$((\text{SOX2} \mid \text{OCT4}) \& \text{NANOG} \& !\text{SNAI1} \& !\text{p53}) \mid (\text{SOX2} \& \text{OCT4} \& (\text{NFkB} \mid \text{TGFB}) \& !\text{p53}) \mid (\text{OCT4} \& \text{NANOG} \& \text{NFkB} \& (!\text{HNF4A} \mid \text{ZEB1} \mid \text{SNAI1}) \& !\text{p53}) \mid (\text{SOX2} \& \text{NANOG} \& \text{NFkB} \& (!\text{HNF4A} \mid \text{ZEB1} \mid \text{SNAI1}) \& !\text{p53}) \mid (!\text{SNAI1} \& (!\text{HNF4A} \mid \text{ZEB1}) \& !\text{NANOG} \& !\text{NFkB} \& !\text{p53} \& !\text{TGFB} \& \text{SOX2} \& \text{OCT4} \& (\text{E2F} \mid \text{Bcatenin}))$$

$$\text{EZH2} = ((\text{E2F} \mid \text{cMyc} \mid \text{Bcatenin} \mid ((\text{TGFB} \mid \text{NFkB}) \& !\text{p53} \& !\text{p14} \& !\text{p16})) \& !\text{p53}) \mid (\text{E2F} \& \text{cMyc} \& \text{Bcatenin})$$

$$\text{EZH2 new function} = ((\text{E2F} \mid ((\text{E2F} \& (\text{NFkB} \mid \text{YAP1} \mid \text{Bcatenin} \mid \text{SOX2}) \& !\text{p53} \& !\text{TGFB} \mid !\text{HNF4A} \mid (!\text{p53} \& !\text{HNF4A}) \mid \text{ZEB1} \mid \text{SNAI1})) \mid ((\text{YAP1} \mid \text{SOX2}) \& (\text{E2F} \mid \text{Bcatenin}) \& !\text{p53} \& !\text{TGFB} \mid (!\text{p53} \& !\text{HNF4A}) \mid \text{ZEB1} \mid \text{SNAI1})) \mid (\text{NFkB} \& !\text{p53} \& (\text{YAP1} \mid \text{E2F}))) \mid \text{Bcatenin} \mid$$

& Bcatenin) = ((E2F | (NFkB & !p53 & (YAP1 | E2F)) | Bcatenin | ((TGFB | NFkB) & !p53 & !p14 & !p16)) & !p53) | (E2F & (!p53 & (!TGFB | !HNF4A | ZEB1 | SNAI1) & (NFkB | YAP1 | Bcatenin | SOX2))) | (NFkB & !p53 & (YAP1 | E2F))) & Bcatenin) =

((E2F | (NFkB & (YAP1 | E2F)) | Bcatenin | ((TGFB | NFkB) & !p14 & !p16)) & !p53) | (E2F & (!p53 & (!TGFB | !HNF4A | ZEB1 | SNAI1) & (NFkB | YAP1 | Bcatenin | SOX2))) | (NFkB & !p53 & (YAP1 | E2F))) & Bcatenin) =

((E2F | (NFkB & YAP1) | Bcatenin | ((TGFB | NFkB) & !p14 & !p16)) & !p53) | (E2F & (!p53 & (!TGFB | !HNF4A | ZEB1 | SNAI1) & (NFkB | YAP1 | Bcatenin | SOX2))) | (NFkB & !p53 & (YAP1 | E2F))) & Bcatenin) =

((E2F | (NFkB & YAP1) | Bcatenin | ((TGFB | NFkB) & !p14 & !p16)) & !p53) | (E2F & Bcatenin & (!p53 & (!TGFB | !HNF4A | ZEB1 | SNAI1) & (NFkB | YAP1 | Bcatenin | SOX2))) | (NFkB & !p53 & (YAP1 | E2F)))) =

((E2F | (NFkB & YAP1) | Bcatenin | ((TGFB | NFkB) & !p14 & !p16)) & !p53) | (E2F & Bcatenin & (!p53 & (!TGFB | !HNF4A | ZEB1 | SNAI1) | (NFkB & (YAP1 | E2F)))) =

((E2F | (NFkB & YAP1) | Bcatenin | ((TGFB | NFkB) & !p14 & !p16)) & !p53) | (E2F & Bcatenin & !p53 & (!TGFB | !HNF4A | ZEB1 | SNAI1 | NFkB)) = !p53 & (E2F | (NFkB & YAP1) | Bcatenin | ((TGFB | NFkB) & !p14 & !p16) | (E2F & Bcatenin & (!TGFB | !HNF4A | ZEB1 | SNAI1 | NFkB))) = !p53 & (E2F | (NFkB & YAP1) | Bcatenin | ((TGFB | NFkB) & !p14 & !p16))

p14 = (!E2F | !cMyc) & !EZH2 & !BMI1

p14 new function = (!E2F | !((E2F & (NFkB | YAP1 | Bcatenin | SOX2) & !p53 & (!TGFB | !HNF4A | (!p53 & !HNF4A) | ZEB1 | SNAI1)) | ((YAP1 | SOX2) & (E2F | Bcatenin) & !p53 & (!TGFB | (!p53 & !HNF4A) | ZEB1 | SNAI1)) | (NFkB & !p53 & (YAP1 | E2F)))) & !EZH2 & !BMI1 =

(!E2F | (!E2F & (NFkB | YAP1 | Bcatenin | SOX2) & !p53 & (!TGFB | !HNF4A | (!p53 & !HNF4A) | ZEB1 | SNAI1)) & !((YAP1 | SOX2) & (E2F | Bcatenin) & !p53 & (!TGFB | (!p53 & !HNF4A) | ZEB1 | SNAI1)) & !(NFkB & !p53 & (YAP1 | E2F)))) & !EZH2 & !BMI1 =

(!E2F | ((!E2F | !(NFkB | YAP1 | Bcatenin | SOX2) | p53 | !(TGFB | !HNF4A | (!p53 & !HNF4A) | ZEB1 | SNAI1)) & !(YAP1 | SOX2) | !(E2F | Bcatenin) | p53 | !(TGFB | (!p53 & !HNF4A) | ZEB1 | SNAI1)) & !(NFkB | p53 | !(YAP1 | E2F)))) & !EZH2 & !BMI1 =

(!E2F | ((!E2F | !(NFkB | YAP1 | Bcatenin | SOX2) | p53 | (TGFB & HNF4A & (p53 | HNF4A) & !ZEB1 & !SNAI1)) & !(YAP1 | SOX2) | !(E2F | Bcatenin) | p53 | (TGFB & (p53 | HNF4A) & !ZEB1 & !SNAI1)) & !(NFkB | p53 | !(YAP1 | E2F)))) & !EZH2 & !BMI1 =

(!E2F | ((!NFkB | YAP1 | Bcatenin | SOX2) | p53 | (TGFB & HNF4A & !ZEB1 & !SNAI1)) & !(YAP1 | SOX2) | !(E2F | Bcatenin) | p53 | (TGFB & HNF4A & !ZEB1 & !SNAI1)) & !(NFkB | p53 | !(YAP1 | E2F)))) & !EZH2 & !BMI1 =

(!E2F | ((!NFkB | YAP1 | Bcatenin | SOX2) | p53 | (TGFB & HNF4A & !ZEB1 & !SNAI1)) & ((YAP1 & !SOX2) | (!E2F & !Bcatenin) | p53 | (TGFB & HNF4A & !ZEB1 & !SNAI1)) & !(NFkB | p53 | !(YAP1 & !E2F)))) & !EZH2 & !BMI1 =

(!E2F | ((!NFkB | YAP1 | Bcatenin | SOX2) | p53 | (TGFB & HNF4A & !ZEB1 & !SNAI1)) & ((YAP1 & !SOX2) | p53 | (TGFB & HNF4A & !ZEB1 & !SNAI1)) & !(NFkB | p53))) & !EZH2 & !BMI1 =

$(!E2F \mid ((p53 \mid (TGFB \& HNF4A \& !ZEB1 \& !SNAI1) \mid (!NFkB \& !YAP1 \& !Bcatenin \& !SOX2) \& (!YAP1 \& !SOX2))) \& (!NFkB \mid p53))) \& !EZH2 \& !BMI1 = (!E2F \mid ((p53 \mid (TGFB \& HNF4A \& !ZEB1 \& !SNAI1) \mid (!NFkB \& !YAP1 \& !Bcatenin \& !SOX2)) \& (!NFkB \mid p53))) \& !EZH2 \& !BMI1$

$= (!E2F \mid ((p53 \mid (TGFB \& HNF4A \& !ZEB1 \& !SNAI1) \mid (!NFkB \& !YAP1 \& !Bcatenin \& !SOX2)) \& (!NFkB \mid p53))) \& !EZH2 \& !BMI1 =$

$(!E2F \mid p53 \mid (((TGFB \& HNF4A \& !ZEB1 \& !SNAI1) \mid (!YAP1 \& !Bcatenin \& !SOX2)) \& !NFkB)) \& !EZH2 \& !BMI1$

$p21 = ((TGFB \mid HNF4A \mid SOX9 \mid FOXA2 \mid p53 \mid NFkB \mid (NANOG \& !SNAI1)) \& !cMyc \& !Bcatenin) \mid (p53 \& (!cMyc \mid !Bcatenin))$

$p21 \text{ new function} = ((TGFB \mid HNF4A \mid SOX9 \mid FOXA2 \mid p53 \mid NFkB \mid (NANOG \& !SNAI1)) \& !(E2F \& (NFkB \mid YAP1 \mid Bcatenin \mid SOX2) \& !p53 \& (!TGFB \mid !HNF4A \mid (!p53 \& !HNF4A) \mid ZEB1 \mid SNAI1))) \mid ((YAP1 \mid SOX2) \& (E2F \mid Bcatenin) \& !p53 \& (!TGFB \mid (!p53 \& !HNF4A) \mid ZEB1 \mid SNAI1))) \mid (NFkB \& !p53 \& (YAP1 \mid E2F))) \& !Bcatenin) \mid (p53 \& !(E2F \& (NFkB \mid YAP1 \mid Bcatenin \mid SOX2) \& !p53 \& (!TGFB \mid !HNF4A \mid (!p53 \& !HNF4A) \mid ZEB1 \mid SNAI1))) \mid ((YAP1 \mid SOX2) \& (E2F \mid Bcatenin) \& !p53 \& (!TGFB \mid (!p53 \& !HNF4A) \mid ZEB1 \mid SNAI1))) \mid (NFkB \& !p53 \& (YAP1 \mid E2F))) \mid !Bcatenin)$

$p16 = (!SNAI2 \mid !BMI1) \& (!E2F \mid !cMyc) \& !EZH2$

$p16 \text{ new function} = (!SNAI2 \mid !BMI1) \& (!E2F \mid !((E2F \& (NFkB \mid YAP1 \mid Bcatenin \mid SOX2) \& !p53 \& (!TGFB \mid !HNF4A \mid (!p53 \& !HNF4A) \mid ZEB1 \mid SNAI1)) \mid ((YAP1 \mid SOX2) \& (E2F \mid Bcatenin) \& !p53 \& (!TGFB \mid (!p53 \& !HNF4A) \mid ZEB1 \mid SNAI1)) \mid (NFkB \& !p53 \& (YAP1 \mid E2F)))))) \& !EZH2$

$HNF4A = ((HNF1A \mid FOXA2 \mid (!NANOG \& !cMyc \& (!NANOG \& !p53) \mid SNAI1 \mid (!SOX9 \mid (!p53 \& !HNF4A) \mid ZEB1)) \& SOX2) \mid HNF6 \mid HNF4A) \& !SNAI1 \& !SNAI2 \& (!NFkB \mid !YAP1 \mid !p53)) \mid (HNF4A \& (HNF1A \mid FOXA2 \mid HNF6) \& (!SNAI2 \mid !SNAI1)) \mid (FOXA2 \& !SNAI1 \& !YAP1 \& !SNAI2 \& !p53) \mid (HNF1A \& (HNF4A \mid FOXA2 \mid HNF6) \& (!SNAI2 \mid !SNAI1) \& !YAP1 \& (!NFkB \mid !p53))) =$

$((HNF1A \mid FOXA2 \mid (!NANOG \& !cMyc \& (!p53 \mid SNAI1 \mid (!SOX9 \mid (!p53 \& !HNF4A) \mid ZEB1)) \& SOX2) \mid HNF6 \mid HNF4A) \& !SNAI1 \& !SNAI2 \& (!NFkB \mid !YAP1 \mid !p53)) \mid (HNF4A \& (HNF1A \mid FOXA2 \mid HNF6) \& (!SNAI2 \mid !SNAI1)) \mid (FOXA2 \& !SNAI1 \& !YAP1 \& !SNAI2 \& !p53) \mid (HNF1A \& (HNF4A \mid FOXA2 \mid HNF6) \& (!SNAI2 \mid !SNAI1) \& !YAP1 \& (!NFkB \mid !p53))) =$

$((HNF1A \mid FOXA2 \mid (!NANOG \& !cMyc \& (!p53 \mid SNAI1 \mid (SOX9 \& (p53 \mid HNF4A) \& !ZEB1)) \& SOX2) \mid HNF6 \mid HNF4A) \& !SNAI1 \& !SNAI2 \& (!NFkB \mid !YAP1 \mid !p53)) \mid (HNF4A \& (HNF1A \mid FOXA2 \mid HNF6) \& (!SNAI2 \mid !SNAI1)) \mid (FOXA2 \& !SNAI1 \& !YAP1 \& !SNAI2 \& !p53) \mid (HNF1A \& (HNF4A \mid FOXA2 \mid HNF6) \& (!SNAI2 \mid !SNAI1) \& !YAP1 \& (!NFkB \mid !p53))) =$

$((HNF1A \mid FOXA2 \mid (!NANOG \& !cMyc \& (!p53 \mid SNAI1 \mid (SOX9 \& !ZEB1)) \& SOX2) \mid HNF6 \mid HNF4A) \& !SNAI1 \& !SNAI2 \& (!NFkB \mid !YAP1 \mid !p53)) \mid (HNF4A \& (HNF1A \mid$

FOXA2 | HNF6) & (!SNAI2 | !SNAI1)) | (FOXA2 & !SNAI1 & !YAP1 & !SNAI2 & !p53) |
 (HNF1A & (HNF4A | FOXA2 | HNF6) & (!SNAI2 | !SNAI1) & !YAP1 & (!NFkB | !p53))

HNF4A new function = ((HNF1A | FOXA2 | (!NANOG & !((E2F & (NFkB | YAP1 | Bcatenin |
 SOX2) & !p53 & (!TGFB | !HNF4A | (!p53 & !HNF4A) | ZEB1 | SNAI1)) | ((YAP1 | SOX2) &
 (E2F | Bcatenin) & !p53 & (!TGFB | (!p53 & !HNF4A) | ZEB1 | SNAI1)) | (NFkB & !p53 &
 (YAP1 | E2F))) & (!p53 | SNAI1 | (SOX9 & !ZEB1)) & SOX2) | HNF6 | HNF4A) & !SNAI1 &
 !SNAI2 & (!NFkB | !YAP1 | !p53)) | (HNF4A & (HNF1A | FOXA2 | HNF6) & (!SNAI2 |
 !SNAI1)) | (FOXA2 & !SNAI1 & !YAP1 & !SNAI2 & !p53) | (HNF1A & (HNF4A | FOXA2 |
 HNF6) & (!SNAI2 | !SNAI1) & !YAP1 & (!NFkB | !p53)) =

((HNF1A | FOXA2 | (!NANOG & !((E2F & (NFkB | YAP1 | Bcatenin | SOX2) & !p53 &
 (!TGFB | !HNF4A | ZEB1 | SNAI1)) & !((YAP1 | SOX2) & (E2F | Bcatenin) & !p53 & (!TGFB
 | !HNF4A | ZEB1 | SNAI1)) & !(NFkB & !p53 & (YAP1 | E2F))) & (!p53 | SNAI1 | (SOX9 &
 !ZEB1)) & SOX2) | HNF6 | HNF4A) & !SNAI1 & !SNAI2 & (!NFkB | !YAP1 | !p53)) | (HNF4A
 & (HNF1A | FOXA2 | HNF6) & (!SNAI2 | !SNAI1)) | (FOXA2 & !SNAI1 & !YAP1 & !SNAI2 &
 !p53) | (HNF1A & (HNF4A | FOXA2 | HNF6) & (!SNAI2 | !SNAI1) & !YAP1 & (!NFkB |
 !p53)) =

((HNF1A | FOXA2 | (!NANOG & !((E2F | !NFkB | YAP1 | Bcatenin | SOX2) | p53 | (TGFB
 & HNF4A & !ZEB1 & !SNAI1)) & !((YAP1 | SOX2) | !E2F | Bcatenin) | p53 | (TGFB &
 HNF4A & !ZEB1 & !SNAI1)) & !(NFkB & !p53 & (YAP1 | E2F))) & (!p53 | SNAI1 | (SOX9 &
 !ZEB1)) & SOX2) | HNF6 | HNF4A) & !SNAI1 & !SNAI2 & (!NFkB | !YAP1 | !p53)) | (HNF4A
 & (HNF1A | FOXA2 | HNF6) & (!SNAI2 | !SNAI1)) | (FOXA2 & !SNAI1 & !YAP1 & !SNAI2 &
 !p53) | (HNF1A & (HNF4A | FOXA2 | HNF6) & (!SNAI2 | !SNAI1) & !YAP1 & (!NFkB |
 !p53)) =

$((\text{HNF1A} \mid \text{FOXA2} \mid (\neg \text{NANOG} \ \& \ (\text{p53} \mid (\text{TGFB} \ \& \ \text{HNF4A} \ \& \ \neg \text{ZEB1} \ \& \ \neg \text{SNAI1}) \mid ((\neg \text{E2F} \mid$
 $\neg (\text{NFkB} \mid \text{YAP1} \mid \text{Bcatenin} \mid \text{SOX2})) \ \& \ (\neg (\text{YAP1} \mid \text{SOX2}) \mid \neg (\text{E2F} \mid \text{Bcatenin})) \ \& \ \neg (\text{NFkB} \ \&$
 $\neg \text{p53} \ \& \ (\text{YAP1} \mid \text{E2F}))) \ \& \ (\neg \text{p53} \mid \text{SNAI1} \mid (\text{SOX9} \ \& \ \neg \text{ZEB1})) \ \& \ \text{SOX2}) \mid \text{HNF6} \mid \text{HNF4A}) \ \&$
 $\neg \text{SNAI1} \ \& \ \neg \text{SNAI2} \ \& \ (\neg \text{NFkB} \mid \neg \text{YAP1} \mid \neg \text{p53})) \mid (\text{HNF4A} \ \& \ (\text{HNF1A} \mid \text{FOXA2} \mid \text{HNF6}) \ \&$
 $(\neg \text{SNAI2} \mid \neg \text{SNAI1})) \mid (\text{FOXA2} \ \& \ \neg \text{SNAI1} \ \& \ \neg \text{YAP1} \ \& \ \neg \text{SNAI2} \ \& \ \neg \text{p53}) \mid (\text{HNF1A} \ \& \ (\text{HNF4A} \mid$
 $\text{FOXA2} \mid \text{HNF6}) \ \& \ (\neg \text{SNAI2} \mid \neg \text{SNAI1}) \ \& \ \neg \text{YAP1} \ \& \ (\neg \text{NFkB} \mid \neg \text{p53})) =$

$((\text{HNF1A} \mid \text{FOXA2} \mid (\neg \text{NANOG} \ \& \ (\text{p53} \mid ((\neg \text{E2F} \mid \neg (\text{NFkB} \mid \text{YAP1} \mid \text{Bcatenin} \mid \text{SOX2})) \ \&$
 $(\neg (\text{YAP1} \mid \text{SOX2}) \mid \neg (\text{E2F} \mid \text{Bcatenin}))) \ \& \ \neg (\text{NFkB} \ \& \ \neg \text{p53} \ \& \ (\text{YAP1} \mid \text{E2F}))) \ \& \ (\neg \text{p53} \mid \text{SNAI1}$
 $\mid (\text{SOX9} \ \& \ \neg \text{ZEB1})) \ \& \ \text{SOX2}) \mid \text{HNF6} \mid \text{HNF4A}) \ \& \ \neg \text{SNAI1} \ \& \ \neg \text{SNAI2} \ \& \ (\neg \text{NFkB} \mid \neg \text{YAP1} \mid$
 $\neg \text{p53})) \mid (\text{HNF4A} \ \& \ (\text{HNF1A} \mid \text{FOXA2} \mid \text{HNF6}) \ \& \ (\neg \text{SNAI2} \mid \neg \text{SNAI1})) \mid (\text{FOXA2} \ \& \ \neg \text{SNAI1} \ \&$
 $\neg \text{YAP1} \ \& \ \neg \text{SNAI2} \ \& \ \neg \text{p53}) \mid (\text{HNF1A} \ \& \ (\text{HNF4A} \mid \text{FOXA2} \mid \text{HNF6}) \ \& \ (\neg \text{SNAI2} \mid \neg \text{SNAI1}) \ \&$
 $\neg \text{YAP1} \ \& \ (\neg \text{NFkB} \mid \neg \text{p53}))$

$\text{TGFB} = (\text{NANOG} \mid \text{cMyc} \mid \neg \text{SOX2}) \ \& \ \neg ((\text{NANOG} \mid \text{p53}) \ \& \ \neg \text{SNAI1} \ \& \ (\neg \text{SOX9} \mid (\neg \text{p53} \ \&$
 $\neg \text{HNF4A}) \mid \text{ZEB1})) \ \& \ \text{YAP1}$

$\text{TGFB new function} = (\text{NANOG} \mid ((\text{E2F} \ \& \ (\text{NFkB} \mid \text{YAP1} \mid \text{Bcatenin} \mid \text{SOX2}) \ \& \ \neg \text{p53} \ \&$
 $(\neg \text{TGFB} \mid \neg \text{HNF4A} \mid (\neg \text{p53} \ \& \ \neg \text{HNF4A}) \mid \text{ZEB1} \mid \text{SNAI1})) \mid ((\text{YAP1} \mid \text{SOX2}) \ \& \ (\text{E2F} \mid \text{Bcatenin})$
 $\ \& \ \neg \text{p53} \ \& \ (\neg \text{TGFB} \mid (\neg \text{p53} \ \& \ \neg \text{HNF4A}) \mid \text{ZEB1} \mid \text{SNAI1})) \mid (\text{NFkB} \ \& \ \neg \text{p53} \ \& \ (\text{YAP1} \mid \text{E2F}))) \mid$
 $\neg \text{SOX2}) \ \& \ \neg ((\text{NANOG} \mid \text{p53}) \ \& \ \neg \text{SNAI1} \ \& \ (\neg \text{SOX9} \mid (\neg \text{p53} \ \& \ \neg \text{HNF4A}) \mid \text{ZEB1})) \ \& \ \text{YAP1}$

CyclinD = (E2F & (YAP1 | cMyc | NFkB | HNF6 | FOXA2 | Bcatenin) & !p16) | ((YAP1 | Bcatenin) & (cMyc | E2F) & !p16) | (YAP1 & Bcatenin & !p16)

CyclinD new function = (E2F & (YAP1 | ((E2F & (NFkB | YAP1 | Bcatenin | SOX2) & !p53 & (!TGFB | !HNF4A | (!p53 & !HNF4A) | ZEB1 | SNAI1)) | ((YAP1 | SOX2) & (E2F | Bcatenin) & !p53 & (!TGFB | (!p53 & !HNF4A) | ZEB1 | SNAI1)) | (NFkB & !p53 & (YAP1 | E2F))) | NFkB | HNF6 | FOXA2 | Bcatenin) & !p16) | ((YAP1 | Bcatenin) & (((E2F & (NFkB | YAP1 | Bcatenin | SOX2) & !p53 & (!TGFB | !HNF4A | (!p53 & !HNF4A) | ZEB1 | SNAI1)) | ((YAP1 | SOX2) & (E2F | Bcatenin) & !p53 & (!TGFB | (!p53 & !HNF4A) | ZEB1 | SNAI1)) | (NFkB & !p53 & (YAP1 | E2F))) | E2F) & !p16) | (YAP1 & Bcatenin & !p16)

SOX2 = ((OCT4 | NANOG) & (Bcatenin | YAP1) & !p53 & !RB & !p21 & !(((HNF4A | OCT4) & !BMI1 & !ZEB1 & !SNAI1) | (p53 & (HNF4A | OCT4) & !BMI1 & (!ZEB1 | !SNAI1))) | !((p53 | HNF4A) & !ZEB1 & !SNAI1))) | (OCT4 & NANOG & (SOX2 | cMyc) & !RB & !p21 & !p53) | (OCT4 & NANOG & Bcatenin & !p21 & !p53) | (NANOG & SOX2 & cMyc & !p53 & !RB & !p21)

SOX2 new function = ((OCT4 | NANOG) & (Bcatenin | YAP1) & !p53 & !RB & !p21 & !(((HNF4A | OCT4) & !BMI1 & !ZEB1 & !SNAI1) | (p53 & (HNF4A | OCT4) & !BMI1 & (!ZEB1 | !SNAI1))) | !((p53 | HNF4A) & !ZEB1 & !SNAI1))) | (OCT4 & NANOG & (SOX2 | ((E2F & (NFkB | YAP1 | Bcatenin | SOX2) & !p53 & (!TGFB | !HNF4A | (!p53 & !HNF4A) | ZEB1 | SNAI1)) | ((YAP1 | SOX2) & (E2F | Bcatenin) & !p53 & (!TGFB | (!p53 & !HNF4A) | ZEB1 | SNAI1)) | (NFkB & !p53 & (YAP1 | E2F)))) & !RB & !p21 & !p53) | (OCT4 & NANOG & Bcatenin & !p21 & !p53) | (NANOG & SOX2 & ((E2F & (NFkB | YAP1 | Bcatenin | SOX2) & !p53 & (!TGFB | !HNF4A | (!p53 & !HNF4A) | ZEB1 | SNAI1)) | ((YAP1 | SOX2) & (E2F |

Bcatenin) & !p53 & (!TGFB | (!p53 & !HNF4A) | ZEB1 | SNAI1)) | (NFkB & !p53 & (YAP1 | E2F))) & !p53 & !RB & !p21)

TELasas = (YAP1 & (Bcatenin | cMyc | ZEB1 | ((NANOG | p53) & !SNAI1 & (!SOX9 | (!p53 & !HNF4A) | ZEB1)))) & !p53 & E2F & (!RB | !TGFB | !SNAI1)) | (cMyc & E2F & (NANOG | p53) & !SNAI1 & (!SOX9 | (!p53 & !HNF4A) | ZEB1) & !TGFB)

TELasas new function = (YAP1 & (Bcatenin | ((E2F & (NFkB | YAP1 | Bcatenin | SOX2) & !p53 & (!TGFB | !HNF4A | !((p53 | HNF4A) & !ZEB1 & !SNAI1)))) | ((YAP1 | SOX2) & (E2F | Bcatenin) & !p53 & (!TGFB | !((p53 | HNF4A) & !ZEB1 & !SNAI1)))) | ZEB1 | ((NANOG | p53) & !SNAI1 & (!SOX9 | (!p53 & !HNF4A) | ZEB1)))) & !p53 & E2F & (!RB | !TGFB | !SNAI1)) | (((E2F & (NFkB | YAP1 | Bcatenin | SOX2) & !p53 & (!TGFB | !HNF4A | !((p53 | HNF4A) & !ZEB1 & !SNAI1)))) | ((YAP1 | SOX2) & (E2F | Bcatenin) & !p53 & (!TGFB | !((p53 | HNF4A) & !ZEB1 & !SNAI1)))) & E2F & (NANOG | p53) & !SNAI1 & (!SOX9 | (!p53 & !HNF4A) | ZEB1) & !TGFB)

Deleted node = p14

p14 regulated nodes = EZH2, p53

$p14 = (!E2F \mid p53 \mid (((TGFB \& HNF4A \& !ZEB1 \& !SNAI1) \mid (!YAP1 \& !Bcatenin \& !SOX2)) \& !NFkB)) \& !EZH2 \& !BMI1$

$EZH2 = !p53 \& (E2F \mid (NFkB \& YAP1) \mid Bcatenin \mid ((TGFB \mid NFkB) \& !p14 \& !p16))$

$EZH2 \text{ new function} = !p53 \& (E2F \mid (NFkB \& YAP1) \mid Bcatenin \mid ((TGFB \mid NFkB) \& !((!E2F \mid p53 \mid (((TGFB \& HNF4A \& !ZEB1 \& !SNAI1) \mid (!YAP1 \& !Bcatenin \& !SOX2)) \& !NFkB)) \& !EZH2 \& !BMI1) \& !p16)) =$

$!p53 \& (E2F \mid (NFkB \& YAP1) \mid Bcatenin \mid ((TGFB \mid NFkB) \& (!(!E2F \mid p53 \mid (((TGFB \& HNF4A \& !ZEB1 \& !SNAI1) \mid (!YAP1 \& !Bcatenin \& !SOX2)) \& !NFkB)) \mid EZH2 \mid BMI1) \& !p16)) =$

$!p53 \& (E2F \mid (NFkB \& YAP1) \mid Bcatenin \mid ((TGFB \mid NFkB) \& ((E2F \& !p53 \& !(((TGFB \& HNF4A \& !ZEB1 \& !SNAI1) \mid (!YAP1 \& !Bcatenin \& !SOX2)) \& !NFkB)) \mid EZH2 \mid BMI1) \& !p16)) =$

$!p53 \& (E2F \mid (NFkB \& YAP1) \mid Bcatenin \mid ((TGFB \mid NFkB) \& (EZH2 \mid BMI1) \& !p16))$

$p53 = (p53 \mid (((NANOG \mid p53) \& !SNAI1 \& (!SOX9 \mid (!p53 \& !HNF4A) \mid ZEB1)) \mid HNF6) \& (!((TGFB \mid NFkB) \mid p53 \mid p14 \mid p16))) \mid (NFkB \& (p53 \mid p14 \mid p16) \& (!p53 \& !HNF4A) \mid ZEB1 \mid SNAI1) \& !OCT4)$

$p53 \text{ new function} = (p53 \mid (((NANOG \mid p53) \& !SNAI1 \& (!SOX9 \mid (!p53 \& !HNF4A) \mid ZEB1)) \mid HNF6) \& (!((TGFB \mid NFkB) \mid p53 \mid (!E2F \mid p53 \mid (((TGFB \& HNF4A \& !ZEB1 \& !SNAI1) \mid (!YAP1 \& !Bcatenin \& !SOX2)) \& !NFkB)) \& !EZH2 \& !BMI1) \mid p16))) \mid (NFkB \&$

$(p53 \mid (!E2F \mid p53 \mid (((TGFB \& HNF4A \& !ZEB1 \& !SNAI1) \mid (!YAP1 \& !Bcatenin \& !SOX2))$
 $\& !NFkB)) \& !EZH2 \& !BMI1) \mid p16) \& ((!p53 \& !HNF4A) \mid ZEB1 \mid SNAI1) \& !OCT4)$

Deleted node = TELasa

TELasa regulated nodes = 0

$TELasa = (YAP1 \& (Bcatenin \mid ((E2F \& (NFkB \mid YAP1 \mid Bcatenin \mid SOX2) \& !p53 \& (!TGFB$
 $\mid !HNF4A \mid !((p53 \mid HNF4A) \& !ZEB1 \& !SNAI1))) \mid ((YAP1 \mid SOX2) \& (E2F \mid Bcatenin) \&$
 $!p53 \& (!TGFB \mid !((p53 \mid HNF4A) \& !ZEB1 \& !SNAI1))) \mid ZEB1 \mid ((NANOG \mid p53) \& !SNAI1$
 $\& (!SOX9 \mid (!p53 \& !HNF4A) \mid ZEB1))) \& !p53 \& E2F \& (!RB \mid !TGFB \mid !SNAI1)) \mid (((E2F \&$
 $(NFkB \mid YAP1 \mid Bcatenin \mid SOX2) \& !p53 \& (!TGFB \mid !HNF4A \mid !((p53 \mid HNF4A) \& !ZEB1 \&$
 $!SNAI1))) \mid ((YAP1 \mid SOX2) \& (E2F \mid Bcatenin) \& !p53 \& (!TGFB \mid !((p53 \mid HNF4A) \& !ZEB1$
 $\& !SNAI1))) \mid E2F \& (NANOG \mid p53) \& !SNAI1 \& (!SOX9 \mid (!p53 \& !HNF4A) \mid ZEB1) \&$
 $!TGFB)$

Simplified hEMT model

$$\text{EZH2} = \text{!p53} \& (\text{E2F} \mid (\text{NFkB} \& \text{YAP1}) \mid \text{Bcatenin} \mid ((\text{TGFB} \mid \text{NFkB}) \& (\text{EZH2} \mid \text{BMI1}) \& \text{!p16}))$$

$$\begin{aligned} \text{BMI1} = & ((\text{E2F} \mid (((\text{YAP1} \mid \text{SOX2}) \& (\text{E2F} \mid \text{Bcatenin}) \& \text{!p53} \& (\text{!TGFB} \mid (\text{!p53} \& \text{!HNF4A}) \mid \\ & \text{ZEB1} \mid \text{SNAI1})) \mid (\text{NFkB} \& \text{!p53} \& (\text{YAP1} \mid \text{E2F})))) \& (\text{SOX9} \mid \text{NANOG} \mid ((\text{SNAI1} \mid \text{NFkB}) \& \\ & ((\text{!p53} \& \text{!HNF4A}) \mid \text{ZEB1} \mid \text{SNAI1}))) \& \text{!}(((\text{HNF4A} \mid \text{OCT4}) \& \text{!BMI1} \& \text{!ZEB1} \& \text{!SNAI1}) \mid \\ & (\text{p53} \& (\text{HNF4A} \mid \text{OCT4}) \& \text{!BMI1} \& (\text{!ZEB1} \mid \text{!SNAI1})))) \mid (\text{E2F} \& ((\text{E2F} \& (\text{NFkB} \mid \text{YAP1} \mid \\ & \text{Bcatenin} \mid \text{SOX2}) \& \text{!p53} \& (\text{!TGFB} \mid \text{!HNF4A} \mid (\text{!p53} \& \text{!HNF4A}) \mid \text{ZEB1} \mid \text{SNAI1})) \mid ((\text{YAP1} \\ & \mid \text{SOX2}) \& (\text{E2F} \mid \text{Bcatenin}) \& \text{!p53} \& (\text{!TGFB} \mid (\text{!p53} \& \text{!HNF4A}) \mid \text{ZEB1} \mid \text{SNAI1})) \mid (\text{NFkB} \& \\ & \text{!p53} \& (\text{YAP1} \mid \text{E2F})))) \mid (\text{E2F} \& \text{!}(((\text{HNF4A} \mid \text{OCT4}) \& \text{!BMI1} \& \text{!ZEB1} \& \text{!SNAI1}) \mid (\text{p53} \& \\ & (\text{HNF4A} \mid \text{OCT4}) \& \text{!BMI1} \& (\text{!ZEB1} \mid \text{!SNAI1})))) \end{aligned}$$

$$\begin{aligned} \text{E2F} = & ((((\text{YAP1} \mid \text{SOX2}) \& (\text{E2F} \mid \text{Bcatenin}) \& \text{!p53} \& (\text{!TGFB} \mid (\text{!p53} \& \text{!HNF4A}) \mid \text{ZEB1} \mid \\ & \text{SNAI1})) \mid (\text{NFkB} \& \text{!p53} \& (\text{YAP1} \mid \text{E2F}))) \mid \text{E2F} \mid \text{YAP1}) \& \text{!RB} \& \text{!p21} \& ((\text{!SNAI1} \& \text{!NFkB}) \\ & \mid (\text{!ZEB1} \& \text{!SNAI1}) \mid \text{!HNF4A})) \mid (((\text{E2F} \& (\text{NFkB} \mid \text{YAP1} \mid \text{Bcatenin} \mid \text{SOX2}) \& \text{!p53} \& \\ & (\text{!TGFB} \mid \text{!HNF4A} \mid (\text{!p53} \& \text{!HNF4A}) \mid \text{ZEB1} \mid \text{SNAI1})) \mid ((\text{YAP1} \mid \text{SOX2}) \& (\text{E2F} \mid \text{Bcatenin}) \\ & \& \text{!p53} \& (\text{!TGFB} \mid (\text{!p53} \& \text{!HNF4A}) \mid \text{ZEB1} \mid \text{SNAI1})) \mid (\text{NFkB} \& \text{!p53} \& (\text{YAP1} \mid \text{E2F}))) \& \\ & \text{E2F} \& \text{!RB}) \mid (\text{YAP1} \& \text{!p21}) \end{aligned}$$

$$\begin{aligned} \text{CyclinD} = & (\text{E2F} \& (\text{YAP1} \mid ((\text{E2F} \& (\text{NFkB} \mid \text{YAP1} \mid \text{Bcatenin} \mid \text{SOX2}) \& \text{!p53} \& (\text{!TGFB} \mid \\ & \text{!HNF4A} \mid (\text{!p53} \& \text{!HNF4A}) \mid \text{ZEB1} \mid \text{SNAI1})) \mid ((\text{YAP1} \mid \text{SOX2}) \& (\text{E2F} \mid \text{Bcatenin}) \& \text{!p53} \& \\ & (\text{!TGFB} \mid (\text{!p53} \& \text{!HNF4A}) \mid \text{ZEB1} \mid \text{SNAI1})) \mid (\text{NFkB} \& \text{!p53} \& (\text{YAP1} \mid \text{E2F}))) \mid \text{NFkB} \mid \\ & \text{HNF6} \mid \text{FOXA2} \mid \text{Bcatenin}) \& \text{!p16}) \mid ((\text{YAP1} \mid \text{Bcatenin}) \& (((\text{E2F} \& (\text{NFkB} \mid \text{YAP1} \mid \\ & \text{Bcatenin} \mid \text{SOX2}) \& \text{!p53} \& (\text{!TGFB} \mid \text{!HNF4A} \mid (\text{!p53} \& \text{!HNF4A}) \mid \text{ZEB1} \mid \text{SNAI1})) \mid ((\text{YAP1} \\ & \mid \text{SOX2}) \& (\text{E2F} \mid \text{Bcatenin}) \& \text{!p53} \& (\text{!TGFB} \mid (\text{!p53} \& \text{!HNF4A}) \mid \text{ZEB1} \mid \text{SNAI1})) \mid (\text{NFkB} \& \\ & \text{!p53} \& (\text{YAP1} \mid \text{E2F}))) \mid \text{E2F}) \& \text{!p16}) \mid (\text{YAP1} \& \text{Bcatenin} \& \text{!p16}) \end{aligned}$$

Bcatenin = (EZH2 & BMI1 & !p53 & !((HNF4A | SOX2) & !ZEB1 & !SNAI2) | !SOX2)) |
(TGFB & !p53 & !SOX2 & !((HNF4A | SOX2) & !ZEB1 & !SNAI2))

RB = !CyclinD | p16 | p21

p21 = ((TGFB | HNF4A | SOX9 | FOXA2 | p53 | NFkB | (NANOG & !SNAI1)) & !((E2F &
(NFkB | YAP1 | Bcatenin | SOX2) & !p53 & (!TGFB | !HNF4A | (!p53 & !HNF4A) | ZEB1 |
SNAI1)) | ((YAP1 | SOX2) & (E2F | Bcatenin) & !p53 & (!TGFB | (!p53 & !HNF4A) | ZEB1 |
SNAI1)) | (NFkB & !p53 & (YAP1 | E2F))) & !Bcatenin) | (p53 & !((E2F & (NFkB | YAP1 |
Bcatenin | SOX2) & !p53 & (!TGFB | !HNF4A | (!p53 & !HNF4A) | ZEB1 | SNAI1)) | ((YAP1
| SOX2) & (E2F | Bcatenin) & !p53 & (!TGFB | (!p53 & !HNF4A) | ZEB1 | SNAI1)) | (NFkB &
!p53 & (YAP1 | E2F))) | !Bcatenin))

HNF4A = ((HNF1A | FOXA2 | (!NANOG & (p53 | (!E2F | !NFkB | YAP1 | Bcatenin |
SOX2)) & !(YAP1 | SOX2) | !(E2F | Bcatenin)))) & !(NFkB & !p53 & (YAP1 | E2F))) &
(!p53 | SNAI1 | (SOX9 & !ZEB1)) & SOX2) | HNF6 | HNF4A) & !SNAI1 & !SNAI2 & (!NFkB
| !YAP1 | !p53)) | (HNF4A & (HNF1A | FOXA2 | HNF6) & (!SNAI2 | !SNAI1)) | (FOXA2 &
!SNAI1 & !YAP1 & !SNAI2 & !p53) | (HNF1A & (HNF4A | FOXA2 | HNF6) & (!SNAI2 |
!SNAI1) & !YAP1 & (!NFkB | !p53))

HNF6 = ((HNF4A | HNF1A) & (((NANOG | p53) & !SNAI1) | HNF6 | SOX9) & (!OCT4 |
!SOX2 | !NANOG)) | (((!NANOG & !p53) | SNAI1) & !NANOG & !OCT4 & !SOX2 & !SOX9
& !HNF6 & !HNF4A & HNF1A) | (((!NANOG & !p53) | SNAI1) & !NANOG & !OCT4 &
!SOX2 & !SOX9 & !HNF6 & HNF4A)

HNF1A = ((HNF4A | FOXA2 | HNF1A) & !SNAI1 & !NFkB) | (HNF4A & (FOXA2 | HNF1A))
| (!HNF1A & !SNAI1 & !FOXA2 & HNF4A & NFkB)

FOXA2 = ((HNF4A | HNF6) & (FOXA2 | SOX9 | Bcatenin) & !SOX2 & (!TGFB | !((HNF4A |
SOX2) & !ZEB1 & !SNAI2))) | (HNF4A & (FOXA2 | HNF6) & !SOX2 & !TGFB)

$$\text{NFkB} = (!\text{NFkB} \& \text{TGFB}) \mid ((\text{p53} \mid \text{HNF4A}) \& !\text{ZEB1} \& !\text{SNAI1} \& !\text{FOXA2} \& \text{NFkB}) \mid (!\text{SOX9} \mid \text{ZEB1}) \mid \text{YAP1} \mid !\text{HNF4A} \mid !\text{HNF1A} \mid !\text{p53} \mid \text{SNAI1}$$

$$\begin{aligned} \text{SNAI1} = & ((\text{TGFB} \mid \text{NFkB} \mid ((\text{E2F} \& (\text{NFkB} \mid \text{YAP1} \mid \text{Bcatenin} \mid \text{SOX2}) \& !\text{p53} \& (!\text{TGFB} \mid \\ & !\text{HNF4A} \mid (!\text{p53} \& !\text{HNF4A}) \mid \text{ZEB1} \mid \text{SNAI1})) \mid ((\text{YAP1} \mid \text{SOX2}) \& (\text{E2F} \mid \text{Bcatenin}) \& !\text{p53} \& \\ & (!\text{TGFB} \mid (!\text{p53} \& !\text{HNF4A}) \mid \text{ZEB1} \mid \text{SNAI1})) \mid (\text{NFkB} \& !\text{p53} \& (\text{YAP1} \mid \text{E2F}))) \mid \text{YAP1}) \& \\ & (!\text{SNAI1} \mid !\text{SNAI2} \mid \text{NANOG} \mid ((\text{E2F} \& (\text{NFkB} \mid \text{YAP1} \mid \text{Bcatenin} \mid \text{SOX2}) \& !\text{p53} \& (!\text{TGFB} \mid \\ & !\text{HNF4A} \mid (!\text{p53} \& !\text{HNF4A}) \mid \text{ZEB1} \mid \text{SNAI1})) \mid ((\text{YAP1} \mid \text{SOX2}) \& (\text{E2F} \mid \text{Bcatenin}) \& !\text{p53} \& \\ & (!\text{TGFB} \mid (!\text{p53} \& !\text{HNF4A}) \mid \text{ZEB1} \mid \text{SNAI1})) \mid (\text{NFkB} \& !\text{p53} \& (\text{YAP1} \mid \text{E2F}))) \mid !\text{SOX2}) \& \\ & ((! \text{p53} \& !\text{HNF4A}) \mid \text{ZEB1} \mid \text{SNAI1}) \& (!\text{HNF4A} \mid !\text{HNF1A})) \mid (\text{NFkB} \& ((\text{E2F} \& (\text{NFkB} \mid \text{YAP1} \\ & \mid \text{Bcatenin} \mid \text{SOX2}) \& !\text{p53} \& (!\text{TGFB} \mid !\text{HNF4A} \mid (!\text{p53} \& !\text{HNF4A}) \mid \text{ZEB1} \mid \text{SNAI1})) \mid \\ & ((\text{YAP1} \mid \text{SOX2}) \& (\text{E2F} \mid \text{Bcatenin}) \& !\text{p53} \& (!\text{TGFB} \mid (!\text{p53} \& !\text{HNF4A}) \mid \text{ZEB1} \mid \text{SNAI1})) \mid \\ & (\text{NFkB} \& !\text{p53} \& (\text{YAP1} \mid \text{E2F}))) \& ((!\text{p53} \& !\text{HNF4A}) \mid \text{ZEB1} \mid \text{SNAI1}) \& !\text{HNF4A} \& \\ & !\text{HNF1A}) \mid (\text{TGFB} \& \text{NFkB} \& (((\text{E2F} \& (\text{NFkB} \mid \text{YAP1} \mid \text{Bcatenin} \mid \text{SOX2}) \& !\text{p53} \& (!\text{TGFB} \mid \\ & !\text{HNF4A} \mid (!\text{p53} \& !\text{HNF4A}) \mid \text{ZEB1} \mid \text{SNAI1})) \mid ((\text{YAP1} \mid \text{SOX2}) \& (\text{E2F} \mid \text{Bcatenin}) \& !\text{p53} \& \\ & (!\text{TGFB} \mid (!\text{p53} \& !\text{HNF4A}) \mid \text{ZEB1} \mid \text{SNAI1})) \mid (\text{NFkB} \& !\text{p53} \& (\text{YAP1} \mid \text{E2F}))) \mid \text{YAP1})) \mid \\ & (\text{NFkB} \& !\text{HNF4A} \& !\text{HNF1A}) \mid ((\text{NANOG} \mid \text{OCT4}) \& (!\text{HNF4A} \mid !\text{HNF1A}) \& (\text{YAP1} \mid ((\text{E2F} \& \\ & (\text{NFkB} \mid \text{YAP1} \mid \text{Bcatenin} \mid \text{SOX2}) \& !\text{p53} \& (!\text{TGFB} \mid !\text{HNF4A} \mid (!\text{p53} \& !\text{HNF4A}) \mid \text{ZEB1} \mid \\ & \text{SNAI1})) \mid ((\text{YAP1} \mid \text{SOX2}) \& (\text{E2F} \mid \text{Bcatenin}) \& !\text{p53} \& (!\text{TGFB} \mid (!\text{p53} \& !\text{HNF4A}) \mid \text{ZEB1} \mid \\ & \text{SNAI1})) \mid (\text{NFkB} \& !\text{p53} \& (\text{YAP1} \mid \text{E2F})))))) \mid (\text{NFkB} \& ((!\text{p53} \& !\text{HNF4A}) \mid \text{ZEB1} \mid \text{SNAI1}) \& \\ & !\text{HNF1A}) \end{aligned}$$

$$\begin{aligned} \text{SNAI2} = & ((\text{SOX9} \mid ((\text{SNAI1} \mid \text{NFkB}) \& ((! \text{p53} \& !\text{HNF4A}) \mid \text{ZEB1} \mid \text{SNAI1})) \mid \text{NFkB} \mid \text{SNAI2}) \\ & \& !\text{HNF4A} \& (!\text{HNF1A} \mid !\text{FOXA2}) \& (!((\text{NANOG} \mid \text{p53}) \& !\text{SNAI1} \& !\text{SOX9} \mid (!\text{p53} \& \\ & !\text{HNF4A}) \mid \text{ZEB1})) \mid !\text{SNAI1}) \& !(((\text{HNF4A} \mid \text{OCT4}) \& !\text{BMI1} \& !\text{ZEB1} \& !\text{SNAI1}) \mid (\text{p53} \& \\ & (\text{HNF4A} \mid \text{OCT4}) \& !\text{BMI1} \& !\text{ZEB1} \mid !\text{SNAI1}))) \& ((! \text{HNF4A} \& !\text{SOX2}) \mid \text{ZEB1} \mid \text{SNAI2})) \mid \\ & ((\text{YAP1} \mid \text{Bcatenin}) \& (\text{NFkB} \mid \text{SNAI2}) \& (!\text{HNF4A} \mid !\text{HNF1A}) \& !\text{FOXA2} \& ((! \text{HNF4A} \& \end{aligned}$$

!SOX2) | ZEB1 | SNAI2) & !(((HNF4A | OCT4) & !BMI1 & !ZEB1 & !SNAI1) | (p53 & (HNF4A | OCT4) & !BMI1 & (!ZEB1 | !SNAI1)))) | (NANOG & (YAP1 | Bcatenin) & (((SNAI1 | NFkB) & (!p53 & !HNF4A) | ZEB1 | SNAI1)) | SNAI2) & (!HNF4A | !HNF1A) & (!HNF4A & !SOX2) | ZEB1 | SNAI2) & !(((HNF4A | OCT4) & !BMI1 & !ZEB1 & !SNAI1) | (p53 & (HNF4A | OCT4) & !BMI1 & (!ZEB1 | !SNAI1))))

ZEB1 = ((SNAI1 | SNAI2 | Bcatenin | NFkB) & !HNF1A & (NANOG | ((E2F & (NFkB | YAP1 | Bcatenin | SOX2) & !p53 & (!TGFB | !HNF4A | (!p53 & !HNF4A) | ZEB1 | SNAI1)) | ((YAP1 | SOX2) & (E2F | Bcatenin) & !p53 & (!TGFB | (!p53 & !HNF4A) | ZEB1 | SNAI1)) | (NFkB & !p53 & (YAP1 | E2F)))) | (p53 & !SOX9) | !SOX2 | ZEB1 | SNAI2 | (!p53 | HNF4A) | SNAI1 | (!HNF4A & !OCT4) | BMI1)) | (SNAI1 & SNAI2 & NFkB & !HNF1A)

YAP1 = SOX2 & Bcatenin & !p53 & !HNF4A

TGFB = (NANOG | ((E2F & (NFkB | YAP1 | Bcatenin | SOX2) & !p53 & (!TGFB | !HNF4A | (!p53 & !HNF4A) | ZEB1 | SNAI1)) | ((YAP1 | SOX2) & (E2F | Bcatenin) & !p53 & (!TGFB | (!p53 & !HNF4A) | ZEB1 | SNAI1)) | (NFkB & !p53 & (YAP1 | E2F)))) | !SOX2) & !((NANOG | p53) & !SNAI1 & (!SOX9 | (!p53 & !HNF4A) | ZEB1)) & YAP1

OCT4 = (SOX2 & NANOG & !p53 & !RB) | ((SOX2 | NANOG) & (OCT4 | ((NANOG | p53) & !SNAI1 & (!SOX9 | (!p53 & !HNF4A) | ZEB1))) & YAP1 & !p53)

SOX2 = ((OCT4 | NANOG) & (Bcatenin | YAP1) & !p53 & !RB & !p21 & !(((HNF4A | OCT4) & !BMI1 & !ZEB1 & !SNAI1) | (p53 & (HNF4A | OCT4) & !BMI1 & (!ZEB1 | !SNAI1)))) | !((p53 | HNF4A) & !ZEB1 & !SNAI1)) | (OCT4 & NANOG & (SOX2 | ((E2F & (NFkB | YAP1 | Bcatenin | SOX2) & !p53 & (!TGFB | !HNF4A | (!p53 & !HNF4A) | ZEB1 | SNAI1)) | ((YAP1 | SOX2) & (E2F | Bcatenin) & !p53 & (!TGFB | (!p53 & !HNF4A) | ZEB1 | SNAI1)) | (NFkB & !p53 & (YAP1 | E2F)))) & !RB & !p21 & !p53) | (OCT4 & NANOG & Bcatenin & !p21 & !p53) | (NANOG & SOX2 & ((E2F & (NFkB | YAP1 | Bcatenin | SOX2) &

$$!p53 \ \& \ (!TGFB \ | \ !HNF4A \ | \ (!p53 \ \& \ !HNF4A) \ | \ ZEB1 \ | \ SNAI1)) \ | \ ((YAP1 \ | \ SOX2) \ \& \ (E2F \ | \ Bcatenin) \ \& \ !p53 \ \& \ (!TGFB \ | \ (!p53 \ \& \ !HNF4A) \ | \ ZEB1 \ | \ SNAI1)) \ | \ (NFkB \ \& \ !p53 \ \& \ (YAP1 \ | \ E2F))) \ \& \ !p53 \ \& \ !RB \ \& \ !p21)$$

$$NANOG = ((SOX2 \ | \ OCT4) \ \& \ NANOG \ \& \ !SNAI1 \ \& \ !p53) \ | \ (SOX2 \ \& \ OCT4 \ \& \ (NFkB \ | \ TGFB) \ \& \ !p53) \ | \ (OCT4 \ \& \ NANOG \ \& \ NFkB \ \& \ (!HNF4A \ | \ ZEB1 \ | \ SNAI1) \ \& \ !p53) \ | \ (SOX2 \ \& \ NANOG \ \& \ NFkB \ \& \ (!HNF4A \ | \ ZEB1 \ | \ SNAI1) \ \& \ !p53) \ | \ (!SNAI1 \ \& \ (!HNF4A \ | \ ZEB1) \ \& \ !NANOG \ \& \ !NFkB \ \& \ !p53 \ \& \ !TGFB \ \& \ SOX2 \ \& \ OCT4 \ \& \ (E2F \ | \ Bcatenin))$$

$$SOX9 = ((!NFkB \ \& \ !FOXA2 \ \& \ SOX9) \ | \ (!NFkB \ \& \ FOXA2) \ | \ NFkB) \ \& \ YAP1$$

$$p16 = (!SNAI2 \ | \ !BMI1) \ \& \ (!E2F \ | \ !((E2F \ \& \ (NFkB \ | \ YAP1 \ | \ Bcatenin \ | \ SOX2) \ \& \ !p53 \ \& \ (!TGFB \ | \ !HNF4A \ | \ (!p53 \ \& \ !HNF4A) \ | \ ZEB1 \ | \ SNAI1)) \ | \ ((YAP1 \ | \ SOX2) \ \& \ (E2F \ | \ Bcatenin) \ \& \ !p53 \ \& \ (!TGFB \ | \ (!p53 \ \& \ !HNF4A) \ | \ ZEB1 \ | \ SNAI1)) \ | \ (NFkB \ \& \ !p53 \ \& \ (YAP1 \ | \ E2F)))) \ \& \ !EZH2$$

$$p53 = (p53 \ | \ (((((NANOG \ | \ p53) \ \& \ !SNAI1 \ \& \ (!SOX9 \ | \ (!p53 \ \& \ !HNF4A) \ | \ ZEB1)) \ | \ HNF6) \ \& \ (!TGFB \ | \ NFkB) \ | \ p53 \ | \ (!E2F \ | \ p53 \ | \ (((TGFB \ \& \ HNF4A \ \& \ !ZEB1 \ \& \ !SNAI1) \ | \ (!YAP1 \ \& \ !Bcatenin \ \& \ !SOX2)) \ \& \ !NFkB)) \ \& \ !EZH2 \ \& \ !BMI1) \ | \ p16))) \ | \ (NFkB \ \& \ (p53 \ | \ (!E2F \ | \ p53 \ | \ (((TGFB \ \& \ HNF4A \ \& \ !ZEB1 \ \& \ !SNAI1) \ | \ (!YAP1 \ \& \ !Bcatenin \ \& \ !SOX2)) \ \& \ !NFkB)) \ \& \ !EZH2 \ \& \ !BMI1) \ | \ p16) \ \& \ (!p53 \ \& \ !HNF4A) \ | \ ZEB1 \ | \ SNAI1) \ \& \ !OCT4)$$