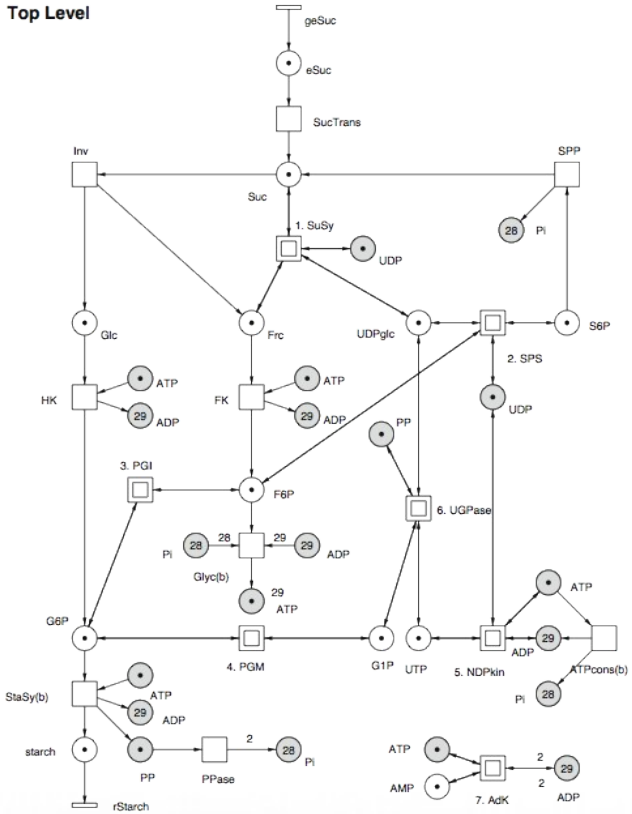
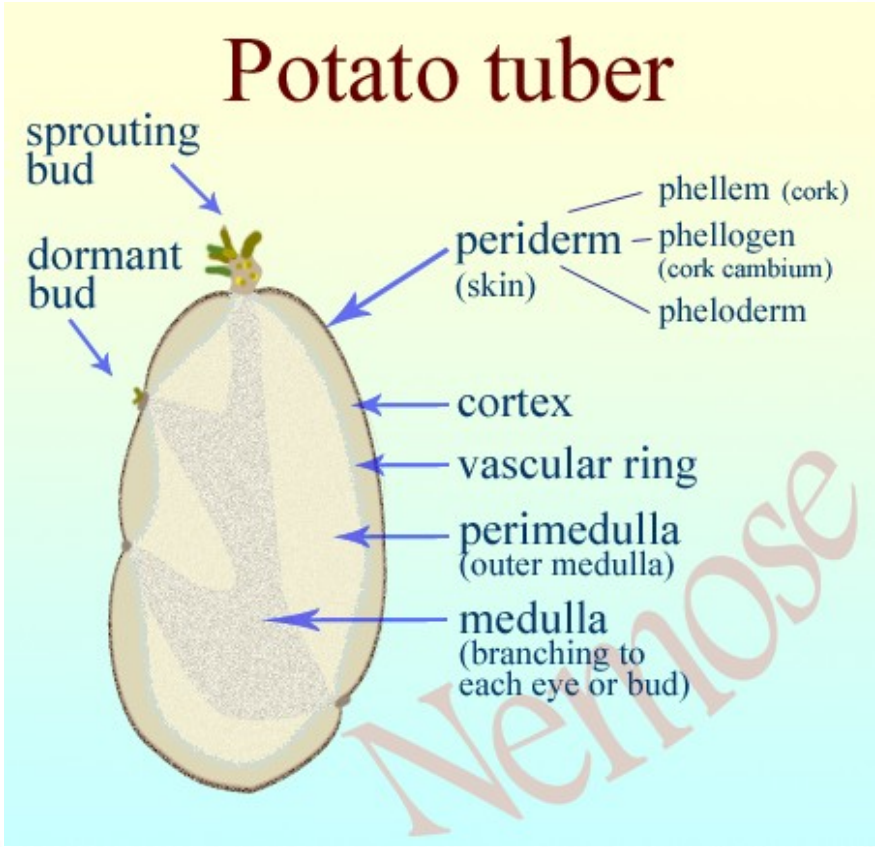
Petri Potato

Presentation about paper: "Application of Petri net theory for modelling and validation of the sucrose breakdown pathway in the potato tuber, Ina Koch , Björn H. Junker and Monika Heiner, 2004"





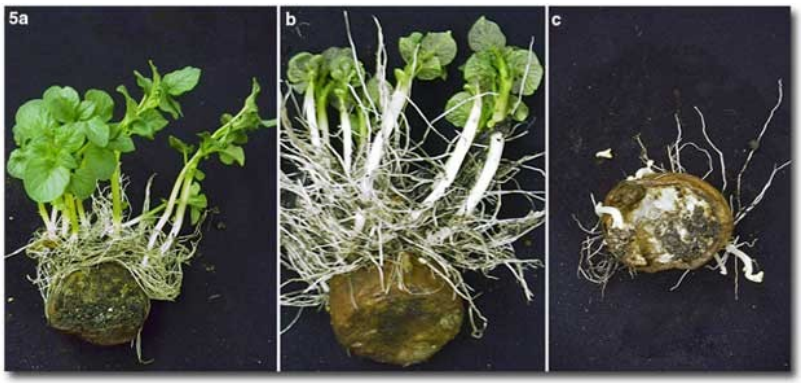
Outline

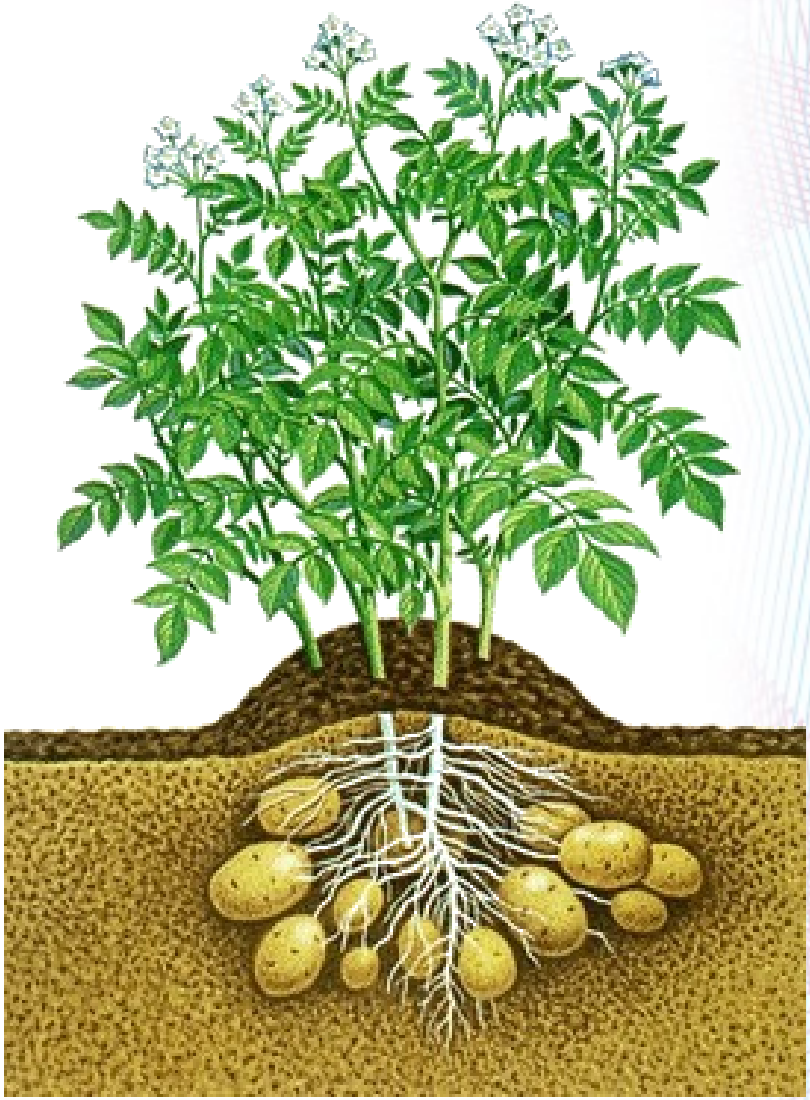
- General process
- Invariants
- Methods
- References
- Remarks
- Questions

Crash course – the basics

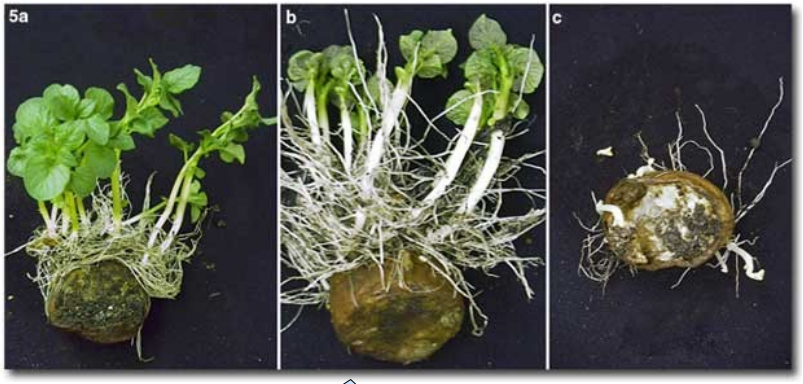
Potato plant cycle

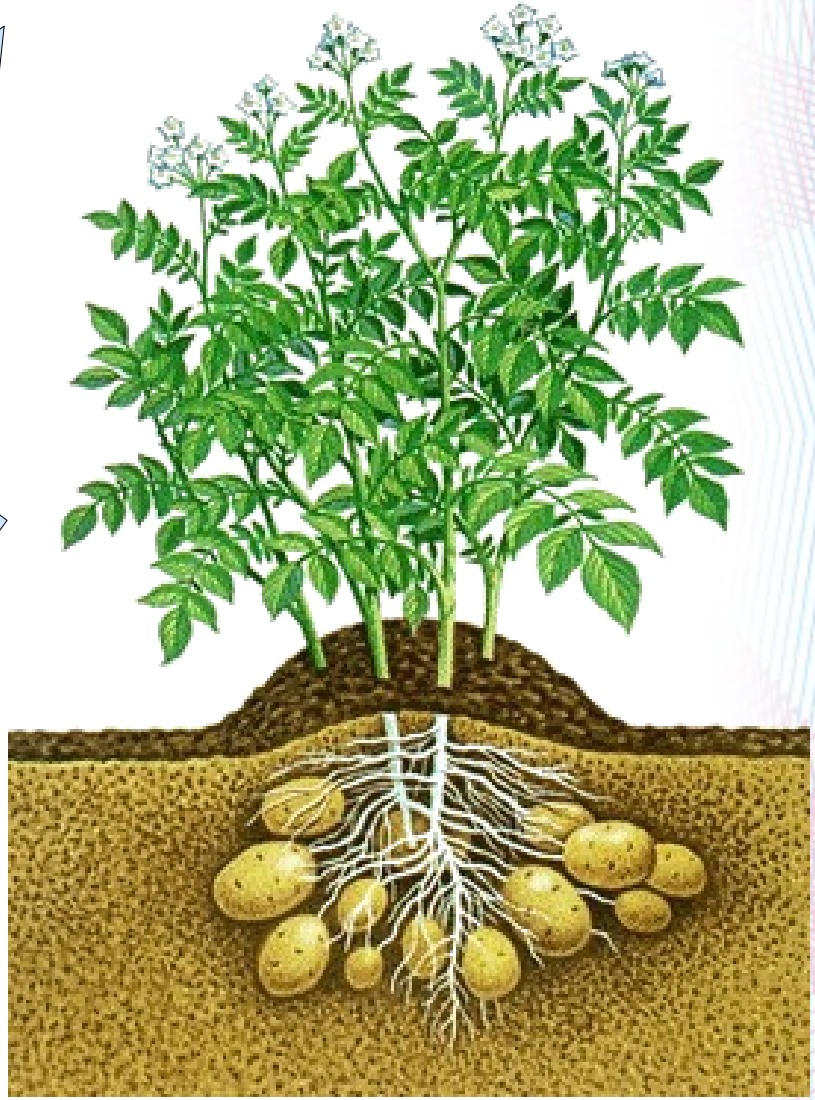
- One potato
- Leaf & roots creation
- New potatos
- Flowers
- Potato plant seeds





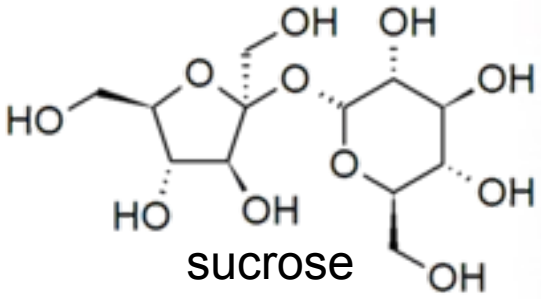
Potato plant cycle



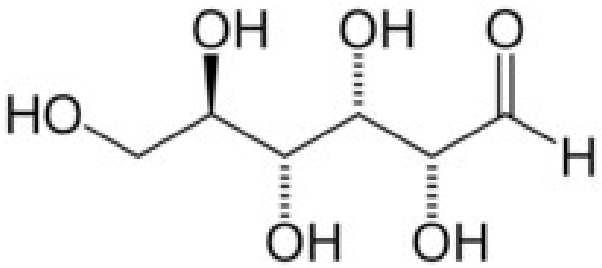


General process growing patato

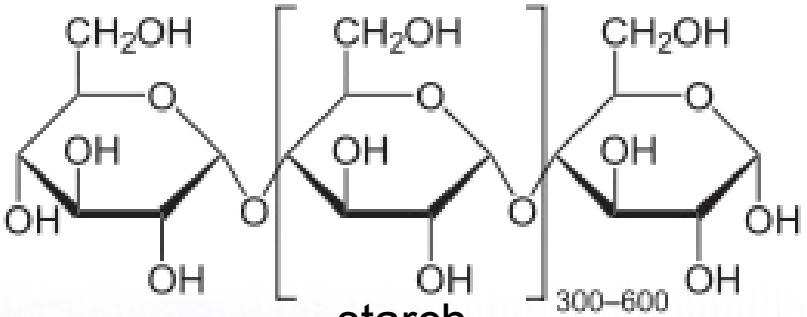
- Potato 'receives' sucrose
- Creates glucose
- Transforms into starch



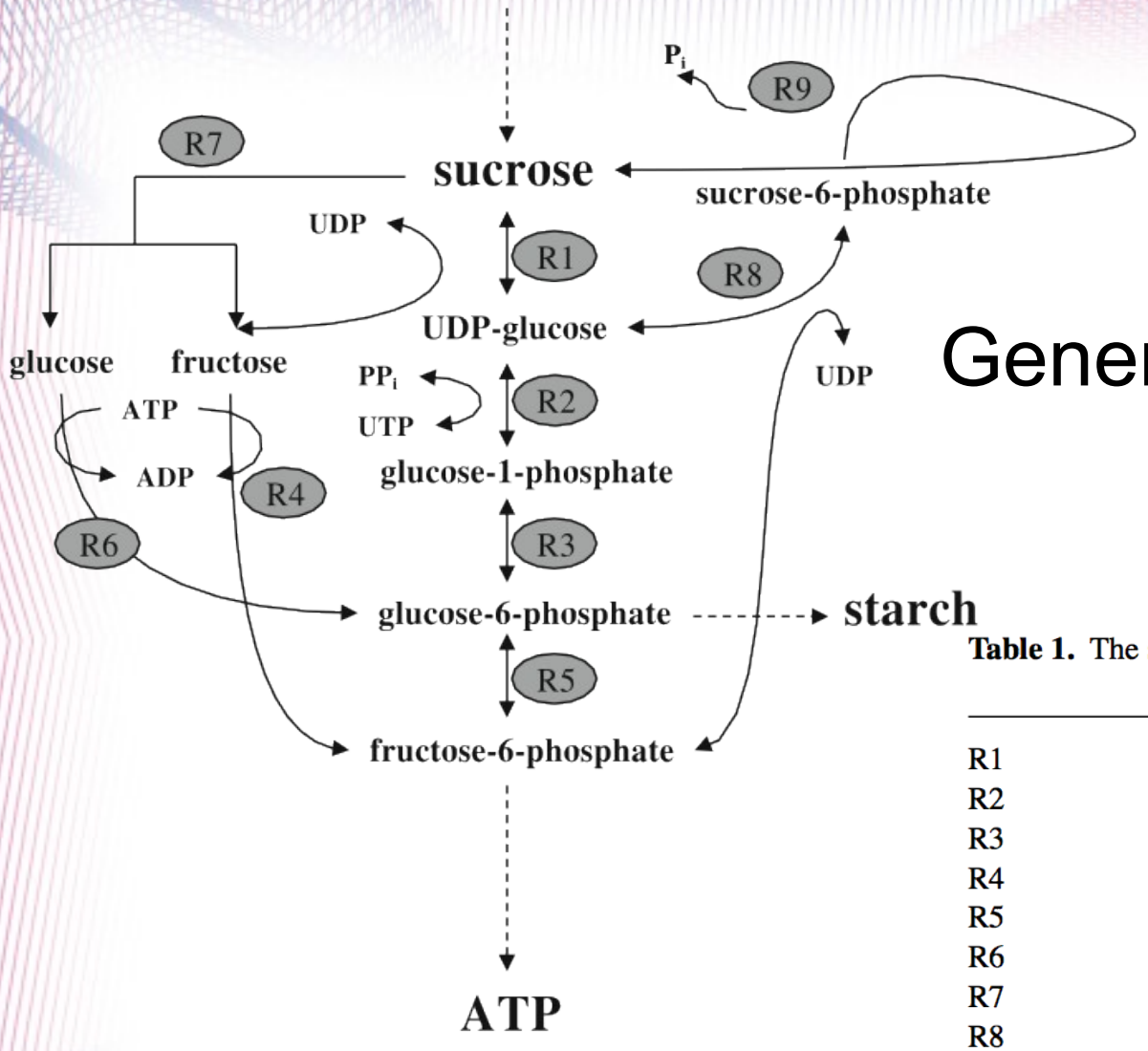
sucrose



glucose



starch



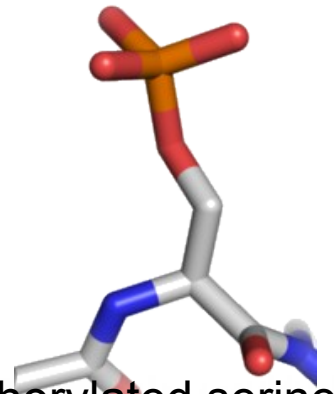
General process modelled

Table 1. The stoichiometric reaction system of the metabolism in Figure 1

R1	SuSy	$Suc + UDP \leftrightarrows UDPglc + Frc$
R2	UGPase	$UDPglc + PP \leftrightarrows G1P + UTP$
R3	PGM	$G6P \leftrightarrows G1P$
R4	FK	$Frc + ATP \rightarrow F6P + ADP$
R5	PGI	$G6P \leftrightarrows F6P$
R6	HK	$Glc + ATP \rightarrow G6P + ADP$
R7	Inv	$Suc \rightarrow Glc + Frc$
R8	SPS	$F6P + UDPglc \leftrightarrows S6P + UDP$
R9	SPP	$S6P \rightarrow Suc + P_i$
R10	Glyc(b)	$F6P + 29\ ADP + 28\ P_i \rightarrow 29\ ATP$
R11	NDPkin	$UDP + ATP \leftrightarrows UTP + ADP$
R12	SucTrans	$eSuc \rightarrow Suc$
R13	ATPcons(b)	$ATP \rightarrow ADP + P_i$
R14	StaSy(b)	$G6P + ATP \rightarrow starch + ADP + PP$
R15	AdK	$ATP + AMP \leftrightarrows 2\ ADP$
R16	PPase	$PP \rightarrow 2P_i$

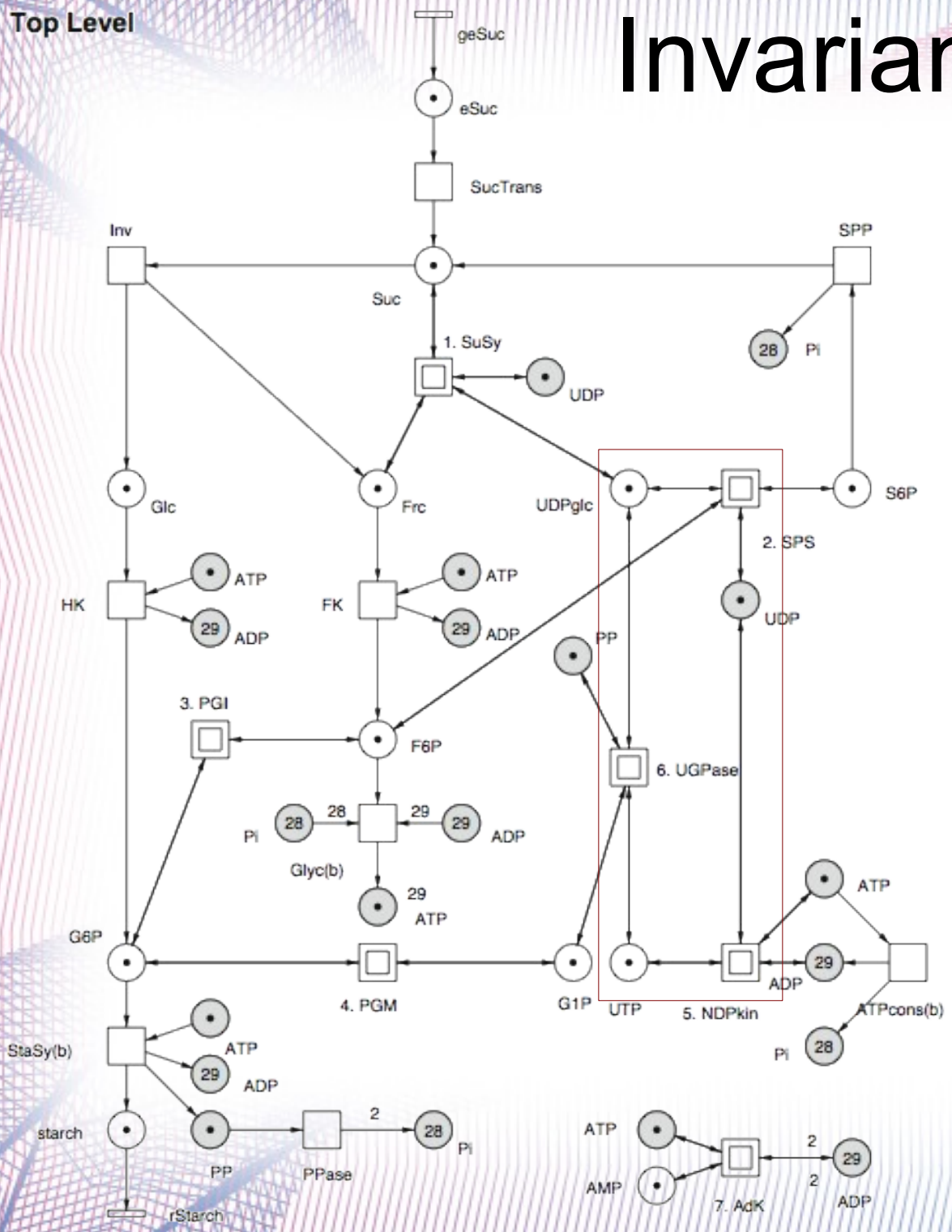
Invariants

Type	Petri nets	Biological
P-invariant	set of places, whose weighted sum of tokens is constant	set of metabolites, whose total net concentrations remain unchanged
T-invariant	set of transitions, whose firing reproduces a given marking indicate the presence of cyclic firing sequences	minimal set of enzymes which could operate at steady state



A phosphorylated serine residue

Invariant - example

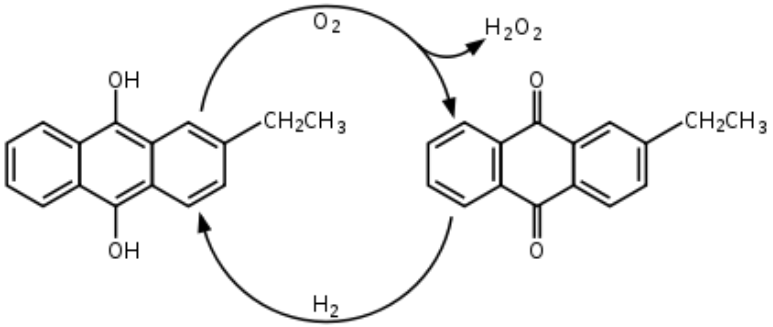


comprise the metabolites containing uridine

Methods

- Reachability analysis for checking correctness
- {T,P}-Invariants for discovering connections
- Petri Net with custom extensions to define model
- Process display purposes

Kinetic modelling vs Petri-nets



Creation of Hydrogen peroxide

$$H_2 + O_2 \rightarrow H_2O_2$$

- Catalyst missing
- Process missing
- Standard structure missing
- Sub-conditions missing
- Not stackable
- Needs supporting text

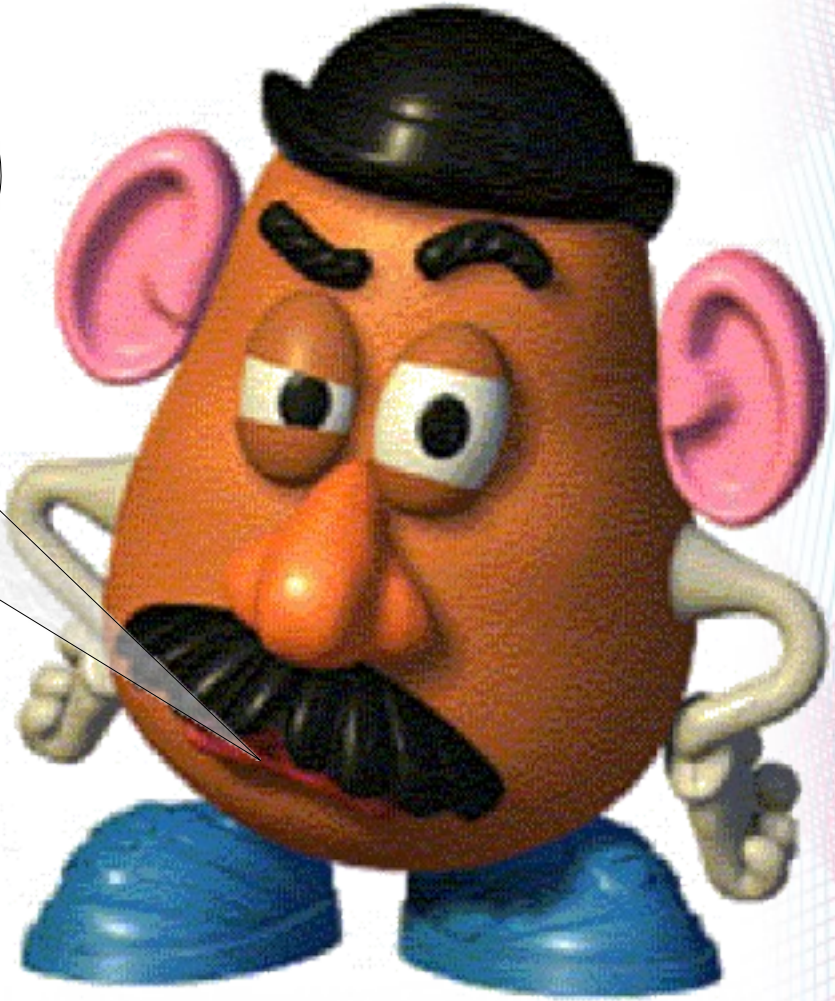
References

- **Application of Petri net theory for modelling and validation of the sucrose breakdown pathway in the potato tuber, Ina Koch , Björn H. Junker and Monika Heiner, 2004"**
  - **http://bioinformatics.oxfordjournals.org/cgi/reprint/21/7/1219.pdf**
  - **http://www.tu-braunschweig.de/Medien-DB/ifm/bs.pdf (presentation)**
- Sucrose breakdown in the potato tuber, Björn H. Junker, 2004
  - Good explanation and simple process description of Sucrose breakdown in the potato tuber
  - http://opus.kobv.de/ubp/volltexte/2005/176/pdf/JUNKER.PDF
- Wikipedia pages for general references and pictures
  - http://en.wikipedia.org/wiki/Starch (example)
- Modelling the Carbohydrate Metabolism in Potato Tuber Cells, Heike E. Assmus (PhD), 2005
  - http://goethe.informatik.uni-rostock.de/~assmus/Research/PhDThesis.pdf

Remarks

- CS students
  - Find papers referring to (part of the) process not focussing on petri-nets
- All
  - Use a Petri-net tool to model the example net
    - example pictures
    - understand inner workings

Questions?



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