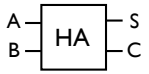
iGEM 2006 ETH
Half Adder

Concepts
Engineering Point
Biological Point

Implementation
Implementation Details
Possible Experiments

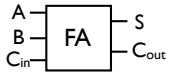
Evaluation

half adder (HA)



- *input*: 2 one-bit numbers A, B
- *output*: 1 two-bit number, arithmetic sum A+B

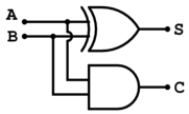
full adder (FA)

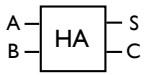


- *input*: 3 one-bit numbers A, B, C_{in}
- *output*: 1 two-bit number, arith. sum A+B+C_{in}

- *n* FA's can be used to construct an *n*-bit adder
- can be constructed with 2 half adders

half adder (HA)

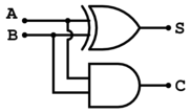




A	B	S	C
0	0	0	0
0	1	1	0
1	0	1	0
1	1	0	1

S = A **xor** B =
(A and not B) or (not A and B) =
(A or B) and (not A or not B)

C = A **and** B

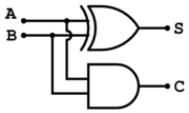


inputs
- A promoter sensitive to *chemical* (to be defined)
- B *light sensitive* promoter (exists)

outputs
- S RFP
- C GFP

Biological Point

logic (gates)



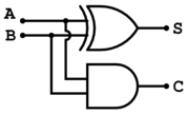
and

- *A* induces prod. of inducer α
- *B* induces production of an inducer β
- αβ complex as inducer for GFP production

- *A* induces prod. of inactive protein (GFP)
- *B* induces production of an activation protein

Biological Point

logic (gates)



xor

- 2 simultaneous ways of RFP production
  - *A* inducer, *B* repressor
  - *B* inducer, *A* repressor

➡ A xor B = (A and not B) or (B and not A)

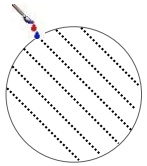
? alternatives ?

Impl. Details

...

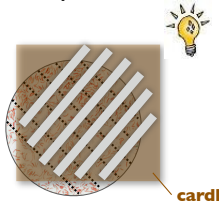
Experiments

1. put chemical to plate

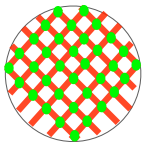


2. let bacteria grow uniformly

3. expose them to light



4. expected result



iGEM 2006 ETH – Half Adder **Experiments**

pattern recognition experiment

- expose bacteria to same pattern twice
  - once with *chemical*
  - once with *light*
- bacteria recognize whether it has been the same pattern
  - ✓ *no reaction*: ok, 2x no stimulus
  - ✓ *green*: ok, 2x stimulation
  - x *red*: not ok, 1x stimulation, 1x without

perfect match | less congruent | playing field

iGEM 2006 ETH – Half Adder **Evaluation**

challenges

- **xor**, and
- light sensitivity:
  - ➡ work in dark room?
  - ➡ additional signal to activate light sensitivity
  - ➡ sensitive to specific light spectrum

pro's & con's

- \+ meaningful from engineering point
- \+ valuable parts for synthetic biology
- \+ experiments visually attractive
- \+ probably simple enough
- – cheap copy of "bio-film" project (iGEM 2004)
- – sensational experiments, have little in common with HA
- – too simple?

iGEM 2006 ETH – Half Adder **Evaluation**

questions?

additions?

comments?

→ Wiki