

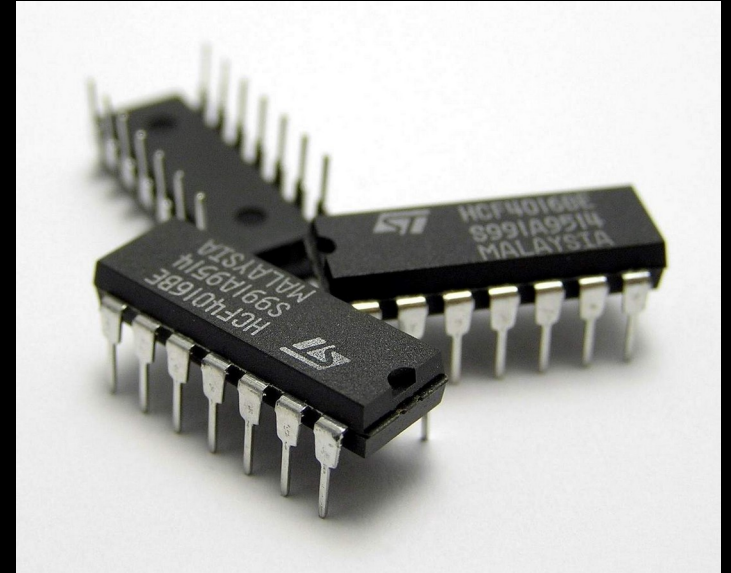
NandSim

Digital Logic Circuit Simulator

Svendeprøve
Simon From Jakobsen
Juni 2026

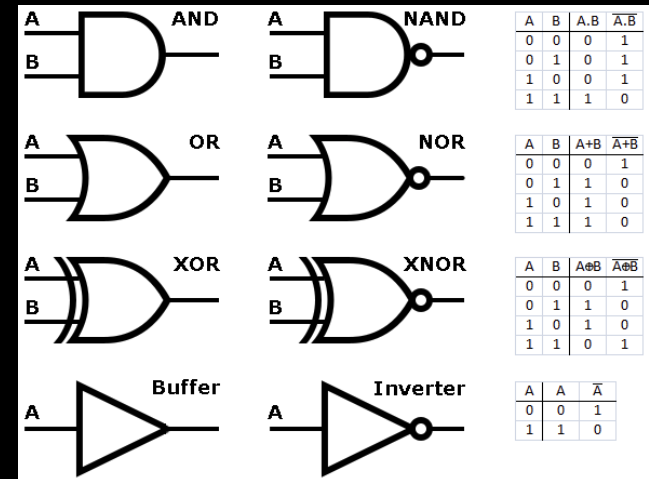
Integrerede kredsløb

- Elektroniske kredsløb
 - ledninger, komponenter, strøm, spænding
- Fotolitografi
- Formål, fx digital-logik
- Samlet pakke
 - inkluderer ofte software



Digital-logik

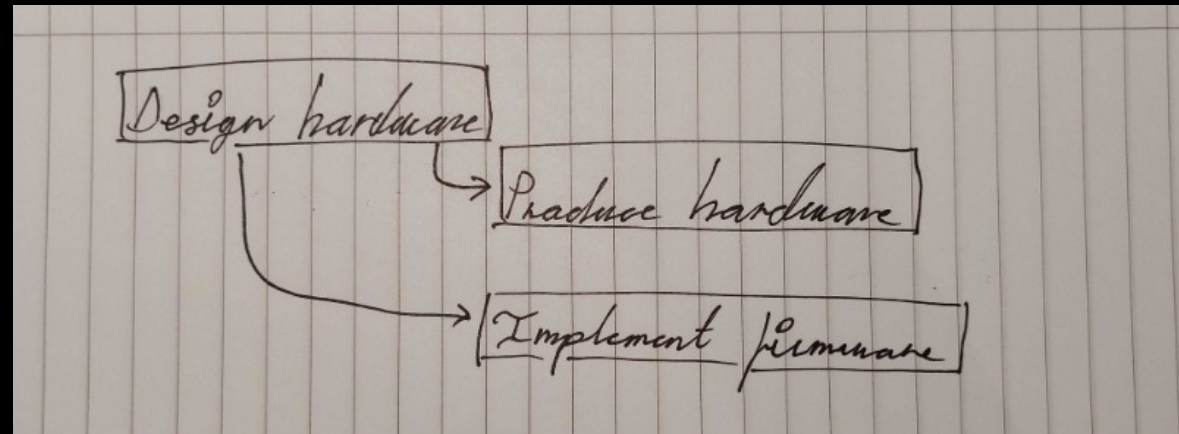
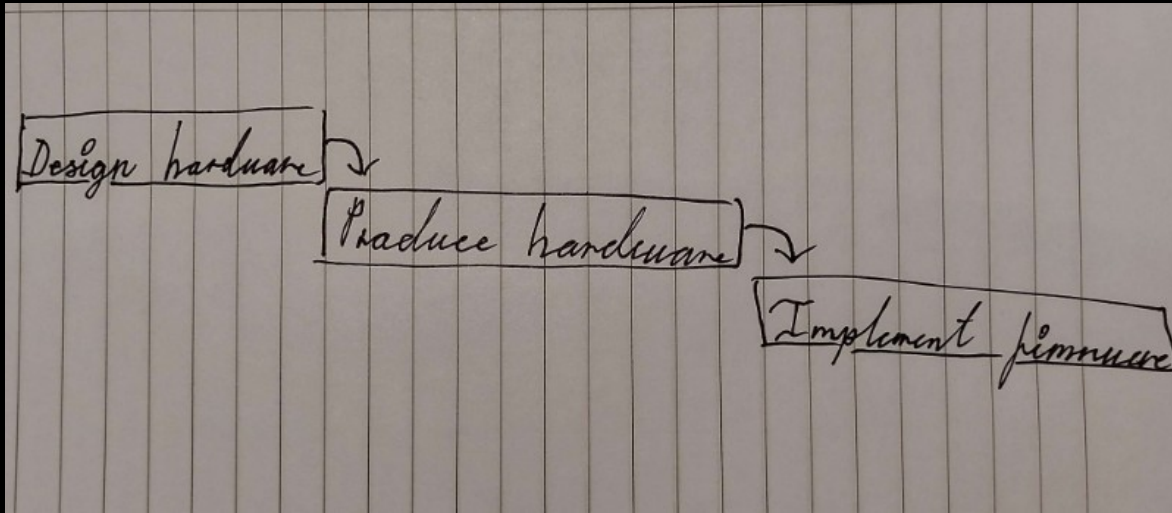
- Digital elektronik
- Binære værdier (1 eller 0, sandt eller falsk...)
- Logik-gates: *AND*, *OR*, *NOT*, ...
- Boolesk algebra: \wedge , \vee , \neg , ...
- Komponering
- Computing



Integreret software

- Firmware
- Drivers
- HAL
- RTOS
- Microcode
- Dataset





nandsim

nandsim — Mozilla Firefox Private Browsing

Private browsing

nandsim.sfja.dk

150%

SaveRenameClose

Toolbar

input
output
and
or
not

(Unnamed)

+

input (off)

input (off)

and

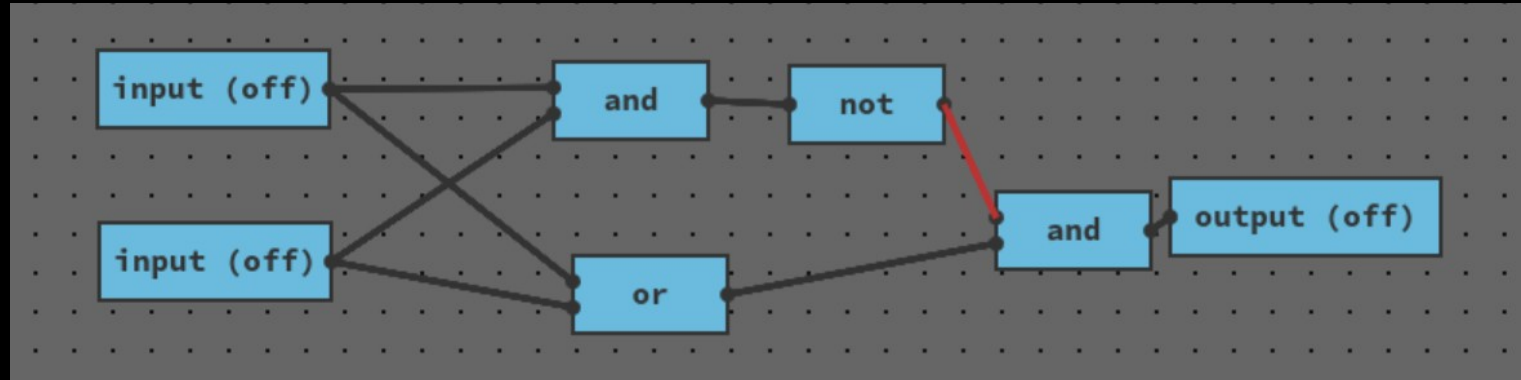
output (off)

```
graph LR; I1["input (off)"] --> A["and"]; I2["input (off)"] --> A; A --> O["output (off)"]
```

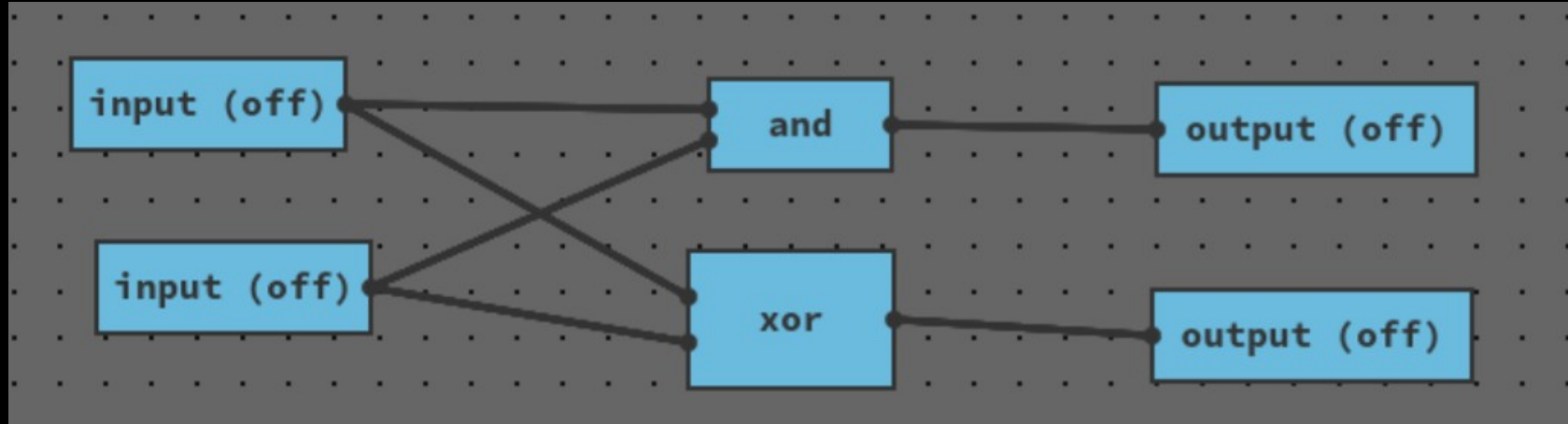
<https://nandsim.sfja.dk/>

Video af demonstration

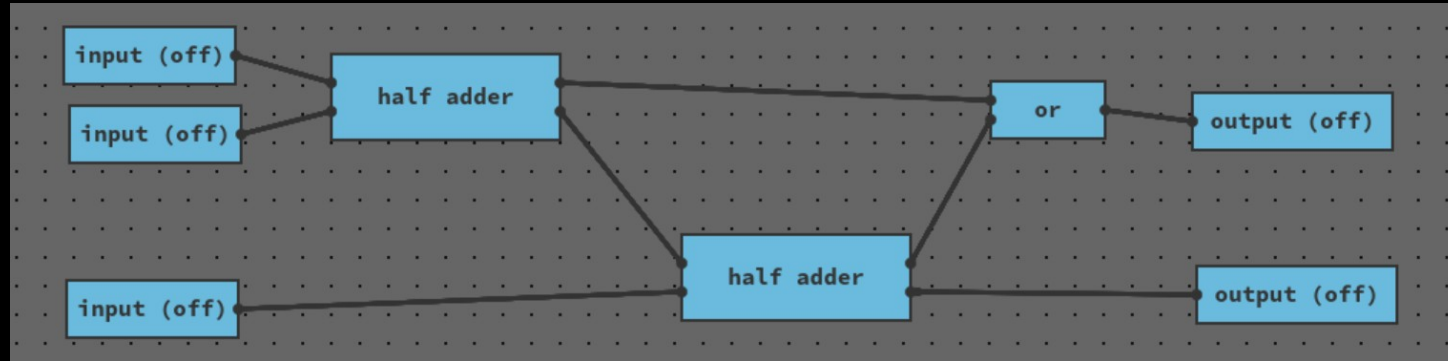
XOR



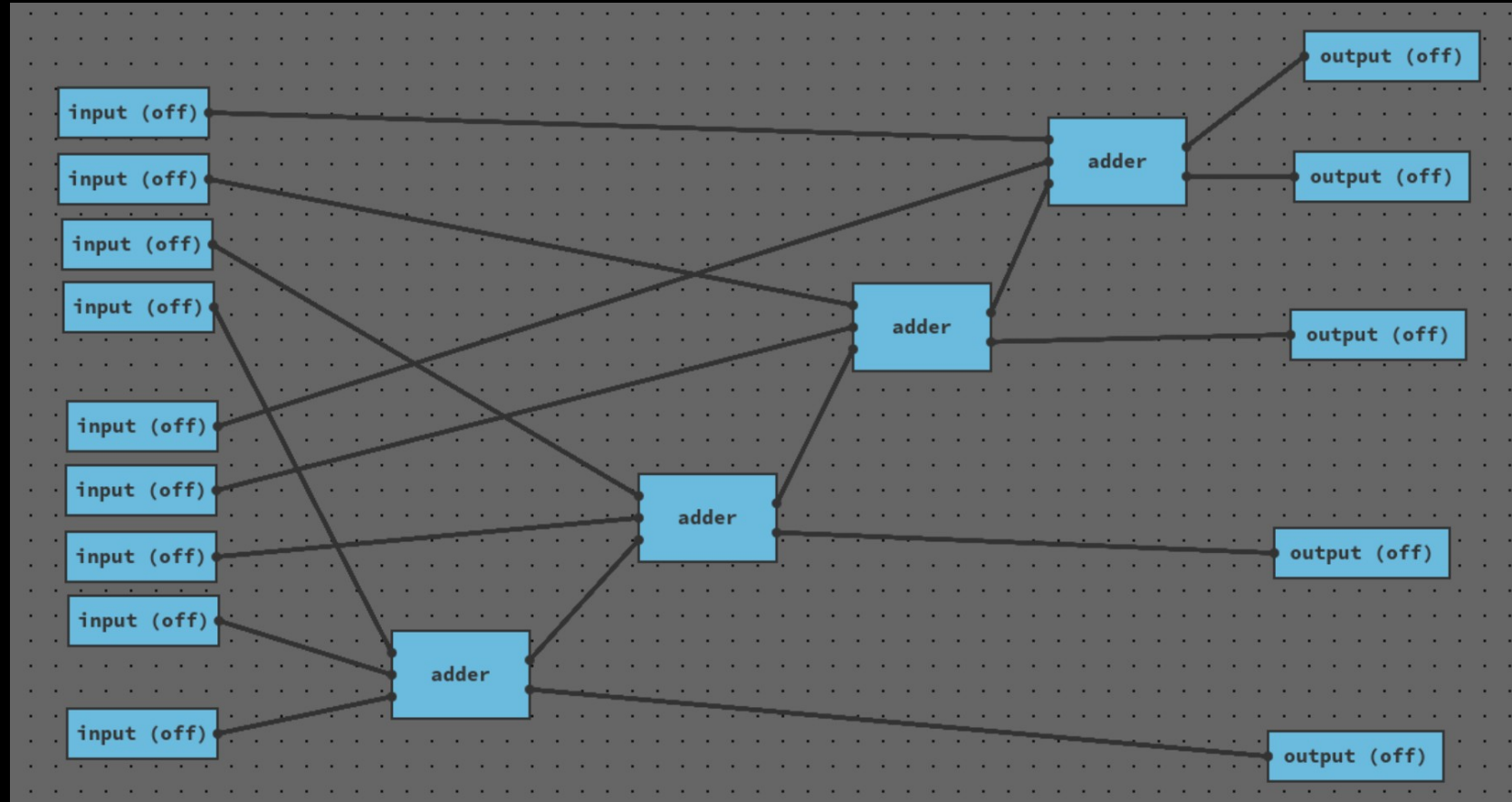
HALF ADDER

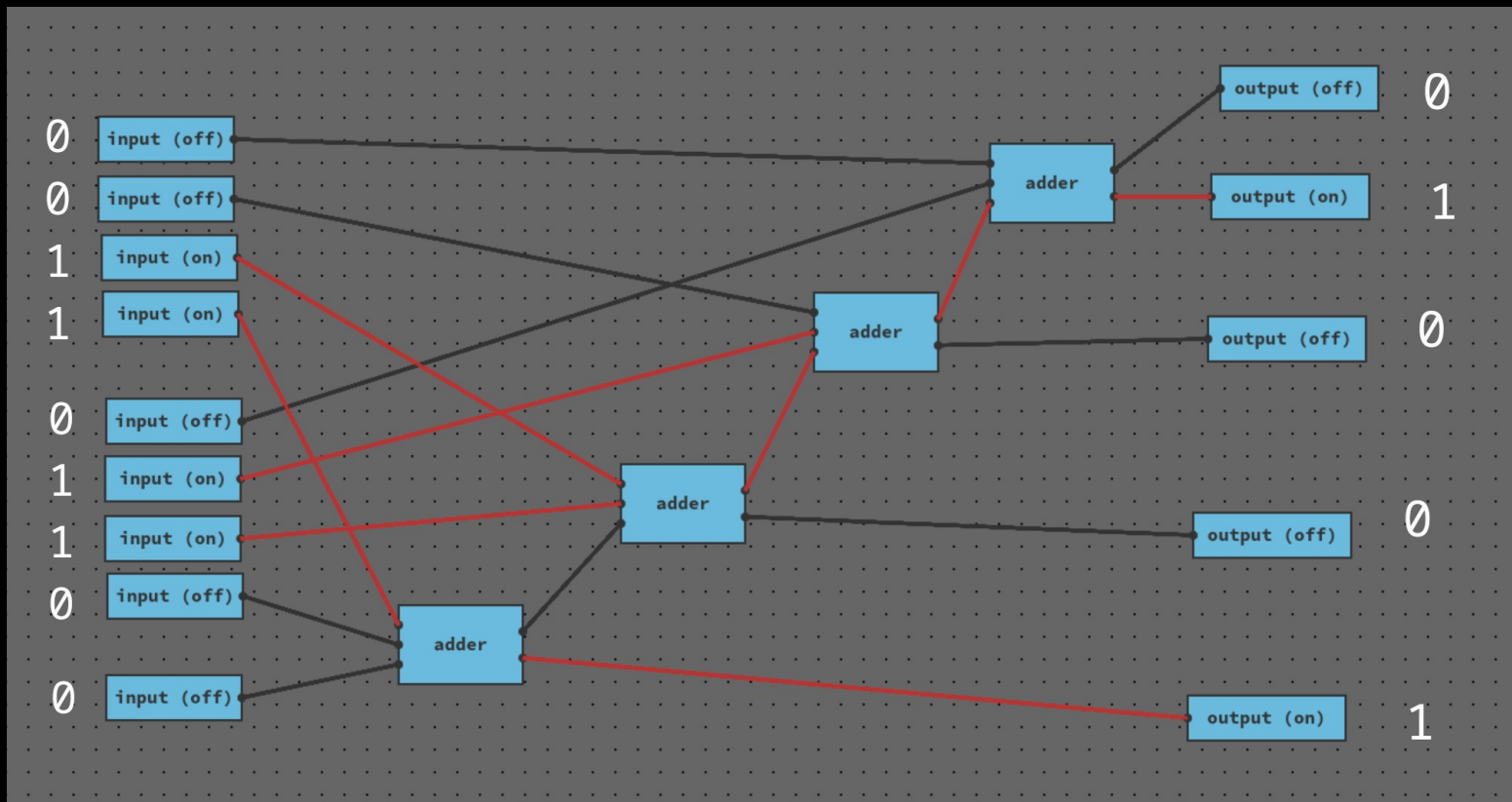


FULL ADDER



4-bit ADDER





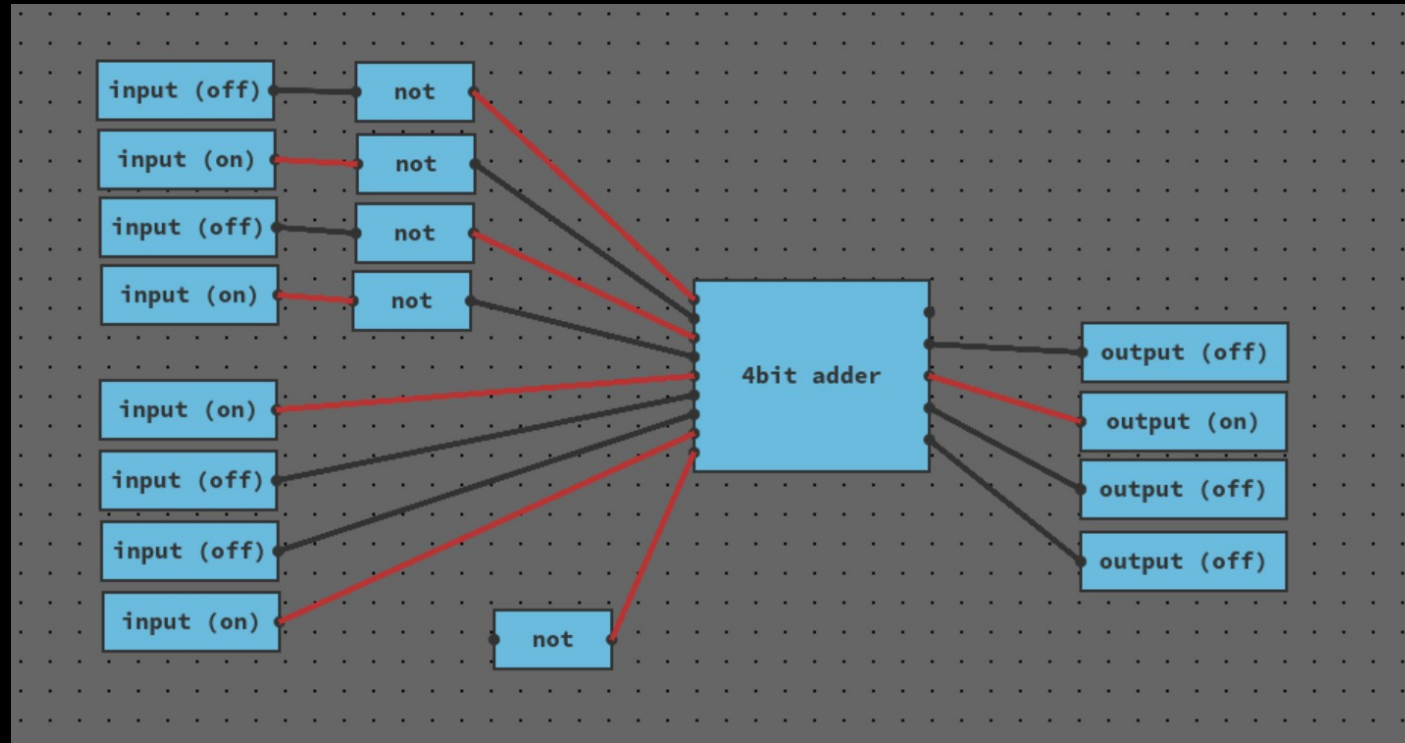
$$3 = 0011$$

$$6 = 0110$$

$$\begin{array}{r} 0011 \\ + 0110 \\ \hline = 1001 \end{array}$$

$$1001 = 9$$

$$3 + 6 = 9$$



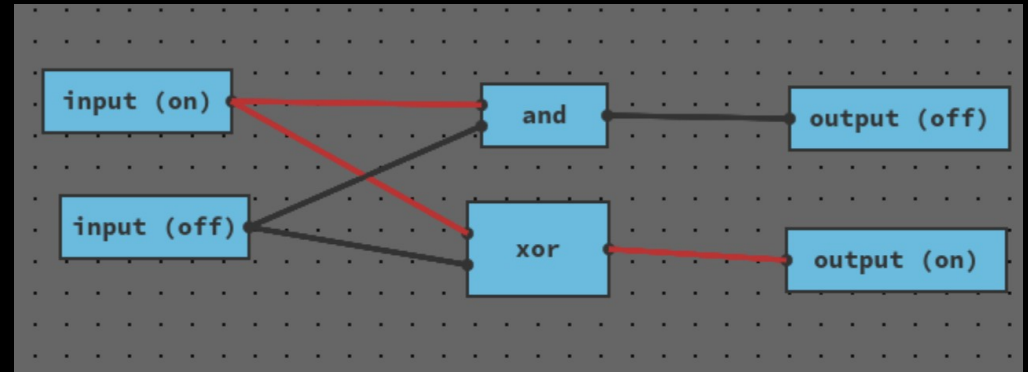
5 = 0101
9 = 1001

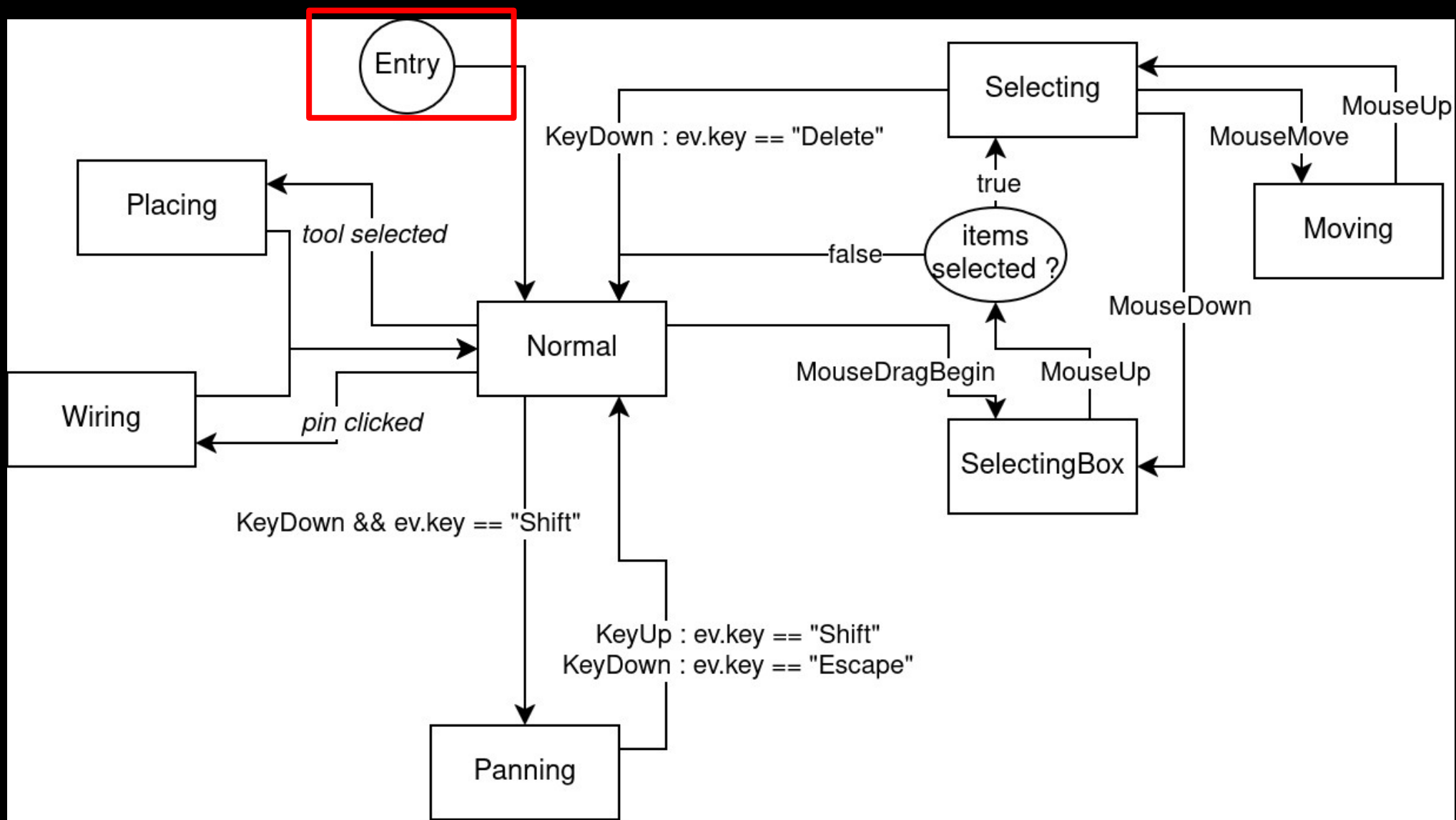
9 - 5 = 4

4 = 0100

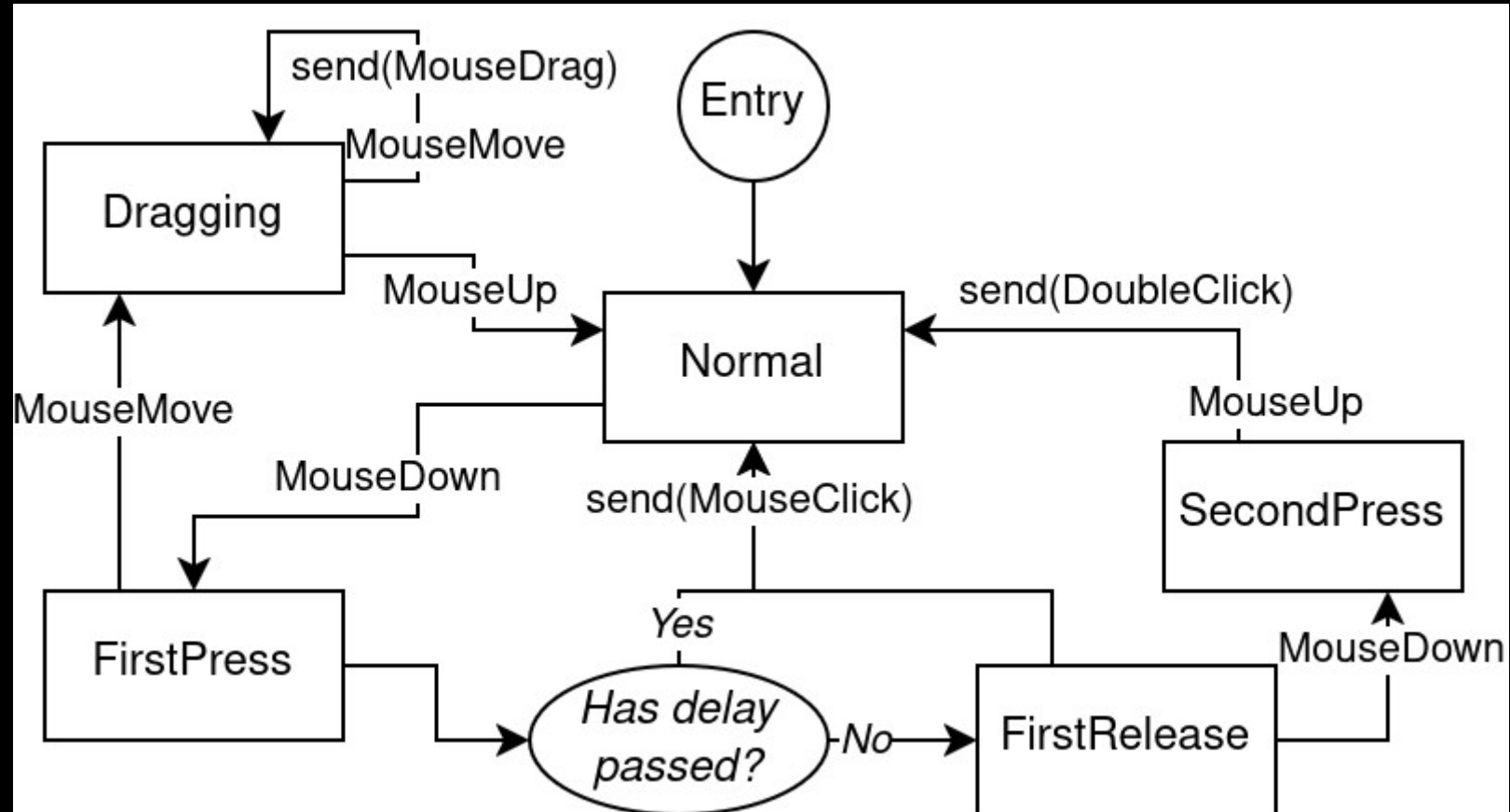
Editor'en

- Visuel
- Kamera
- Selection
- Interaktion
- Flere modes

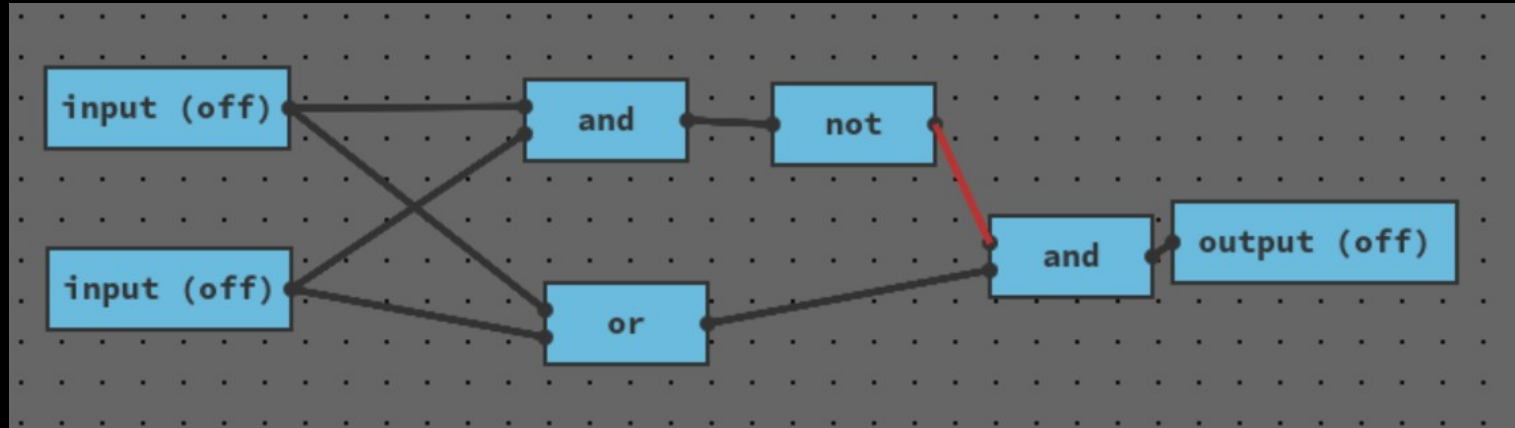




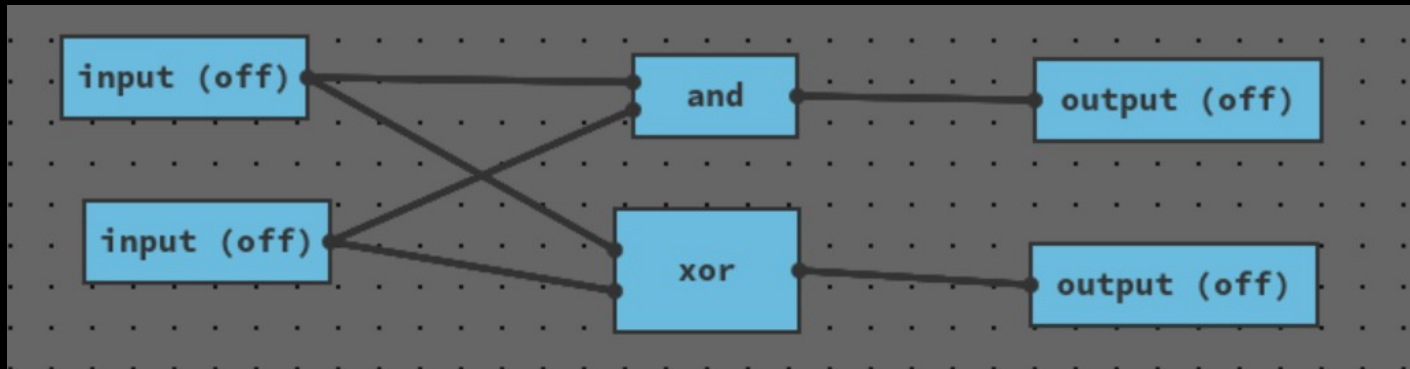
Mouse



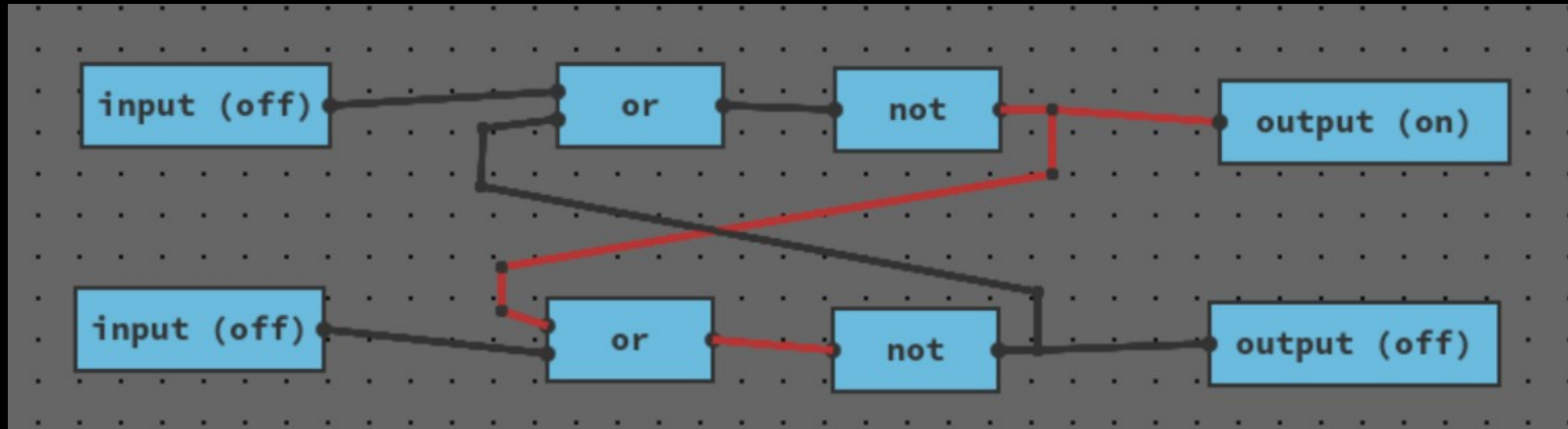
IR / Simulation



```
component xor 2 1 {  
  state [ ]  
  %0 = Input 0  
  %1 = Input 1  
  %2 = Nand %0, %1  
  %3 = Or %0, %1  
  %4 = And %2, %3  
  Output 0, %4  
}
```




```
component half adder 2 2 {  
  state [ ]  
  %0 = Input 0  
  %1 = Input 1  
  %2 = Call xor (%0, %1)  
  %3 = Elem %2, 0  
  Output 1, %3  
  %4 = And %0, %1  
  Output 0, %4  
}
```



```
component rs_latch 2 2 {  
    state [ #0 ]  
    %0 = Input 0  
    %1 = Input 1  
    %2 = GetState #0  
    %3 = Nor %0, %2  
    %4 = Nor %3, %1  
    SetState #0, %4  
    Output 1, %4  
    Output 0, %3  
}
```

```
412  
413 eliminateUnusedStmts() {  
414     const mut = new StmtMutater(this.comp, this.replacedStates);  
415  
416     const useCount = new Map<Stmt, number>();  
417     for (const stmt of mut) {  
418         for (const src of stmt.sources()) {  
419             useCount.set(src, (useCount.get(src) ?? 0) + 1);  
420         }  
421     }  
422  
423     const nonEffectfulStmts = new Set<StmtKind["tag"]>([  
424         "And", "Or", "Nand", "Nor", "Elem", "Input", "GetState", "Null",  
425     ]);  
426  
427     for (const stmt of mut) {  
428         if (!useCount.get(stmt) && nonEffectfulStmts.has(stmt.kind.tag)) {  
429             mut.removeStmt(stmt);  
430         }  
431     }  
432 }  
433
```

```
component <main> 1 1 {  
  state [ #0 ]  
  %0 = Input 0  
  %1 = Not %0  
  Output 0, %0  
}
```



```
component <main> 1 1 {  
  state [ #0 ]  
  %0 = Input 0  
  Output 0, %0  
}
```

```

26   for (let i = 0; i < comp.stmts.length; ++i) {
27       const stmt = comp.stmts[i];
28       const k = stmt.kind;
29       switch (k.tag) {
30           case "Null":
31               regs[i] = false;
32               break;
33           case "Input":
34               regs[i] = inputs[k.i];
35               break;
36           case "Output":
37               outputs[k.i] = regs[stmtIds.get(k.src)!];
38               break;
39 >       case "GetState": ...
49 >       case "SetState": { ...
59           }
60       case "Not":
61           regs[i] = operation((v) => !v, k.op);
62           break;
63       case "And":
64           regs[i] = operation((a, b) => a && b, k.lhs, k.rhs);
65           break;
66       case "Or":
67           regs[i] = operation((a, b) => a || b, k.lhs, k.rhs);
68           break;
69       case "Nand":
70           regs[i] = operation((a, b) => !(a && b), k.lhs, k.rhs);
71           break;
72       case "Nor":
73           regs[i] = operation((a, b) => !(a || b), k.lhs, k.rhs);
74           break;
75 >       case "Call": { ...
85           }
86 >       case "Elem": { ...
93           }

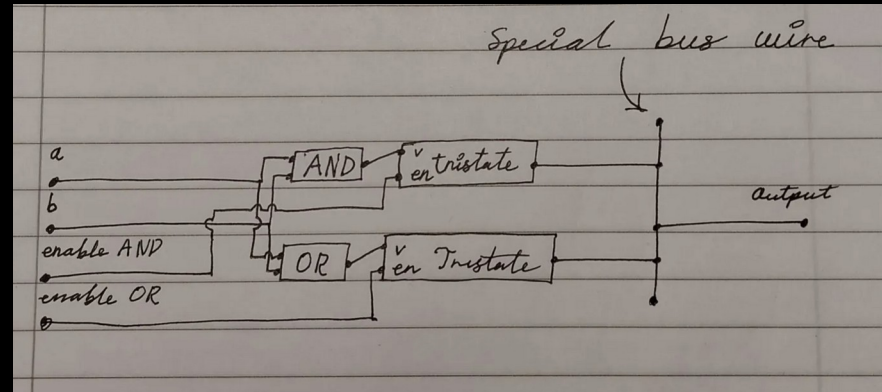
```


Ting der kan forbedres

- Musefunktioner virker suboptimalt
- Man kan ikke zoome
- Tabs og save-funktionalitet har huller
- Wire-stilen er grim
- Event-systemet er rodet

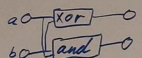
Ting jeg ikke nåede

- Importering af data
- Cloud-miljø
- CI-setup
- Native-afvikling
- Low impedance/Tri-state

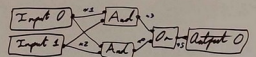
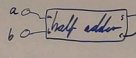


Konklusion

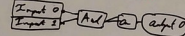
half adder:



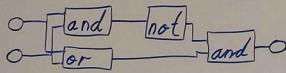
full adder:



In this case collapse the And's.



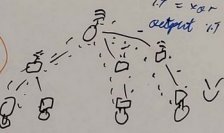
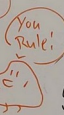
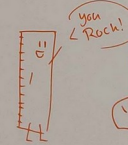
XOR:



input a, b, c, d
e = and a, b
f = and c, d

{e, f} = and {a, b}, {c, d}

ac
0000
b d
0000
e f
0000



component xor
input x1, x2
13 = and x1, x2
14 = or x1, x2
15 = not x3
16 = and x5, x4
output 16

#KARNAUGH

component xor2
input x1, x2, x3, x4
15 = xor x1, x3
16 = xor x2, x4
output 15, 16

component a
input x1, x2, x3, x4
15, 16 = xor2 x1, x2, x3, x4
output 17

The answer is yes, because if there is a dependency that dependency will show up in the value-graph, i.e. in this case the SubState can't be reached beyond the output OutState, because the former depends on the latter in the value-graph, e.g.:
x3 → x4 → x5
(The ordering is fixed)

TOPSDAG:

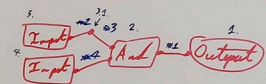
- STOLE OP
- LEDNINGER VÆK FRA GULVE K.A.T.

Mags-000

Merc1234!

SPS koordination, Katrine
Kaso (Skriver gerne på Teams)

MIS.



Forward traverse

1. x1 = OutState
2. Output 0, 1
3. x2 = OutState
4. x3 = OutState
5. x4 = And x1, x2
6. x5 = Input 0
7. x6 = SubState
8. x7 = Input 1
9. x8 = And x5, x6
10. x9 = And x7, x8
11. x10 = And x4, x9
12. x11 = And x10, x3
13. x12 = And x11, x2
14. x13 = And x12, x1
15. x14 = And x13, x1
16. x15 = And x14, x1
17. x16 = And x15, x1
18. x17 = And x16, x1
19. x18 = And x17, x1
20. x19 = And x18, x1
21. x20 = And x19, x1
22. x21 = And x20, x1
23. x22 = And x21, x1
24. x23 = And x22, x1
25. x24 = And x23, x1
26. x25 = And x24, x1
27. x26 = And x25, x1
28. x27 = And x26, x1
29. x28 = And x27, x1
30. x29 = And x28, x1
31. x30 = And x29, x1
32. x31 = And x30, x1
33. x32 = And x31, x1
34. x33 = And x32, x1
35. x34 = And x33, x1
36. x35 = And x34, x1
37. x36 = And x35, x1
38. x37 = And x36, x1
39. x38 = And x37, x1
40. x39 = And x38, x1
41. x40 = And x39, x1
42. x41 = And x40, x1
43. x42 = And x41, x1
44. x43 = And x42, x1
45. x44 = And x43, x1
46. x45 = And x44, x1
47. x46 = And x45, x1
48. x47 = And x46, x1
49. x48 = And x47, x1
50. x49 = And x48, x1
51. x50 = And x49, x1
52. x51 = And x50, x1
53. x52 = And x51, x1
54. x53 = And x52, x1
55. x54 = And x53, x1
56. x55 = And x54, x1
57. x56 = And x55, x1
58. x57 = And x56, x1
59. x58 = And x57, x1
60. x59 = And x58, x1
61. x60 = And x59, x1
62. x61 = And x60, x1
63. x62 = And x61, x1
64. x63 = And x62, x1
65. x64 = And x63, x1
66. x65 = And x64, x1
67. x66 = And x65, x1
68. x67 = And x66, x1
69. x68 = And x67, x1
70. x69 = And x68, x1
71. x70 = And x69, x1
72. x71 = And x70, x1
73. x72 = And x71, x1
74. x73 = And x72, x1
75. x74 = And x73, x1
76. x75 = And x74, x1
77. x76 = And x75, x1
78. x77 = And x76, x1
79. x78 = And x77, x1
80. x79 = And x78, x1
81. x80 = And x79, x1
82. x81 = And x80, x1
83. x82 = And x81, x1
84. x83 = And x82, x1
85. x84 = And x83, x1
86. x85 = And x84, x1
87. x86 = And x85, x1
88. x87 = And x86, x1
89. x88 = And x87, x1
90. x89 = And x88, x1
91. x90 = And x89, x1
92. x91 = And x90, x1
93. x92 = And x91, x1
94. x93 = And x92, x1
95. x94 = And x93, x1
96. x95 = And x94, x1
97. x96 = And x95, x1
98. x97 = And x96, x1
99. x98 = And x97, x1
100. x99 = And x98, x1
101. x100 = And x99, x1
102. x101 = And x100, x1
103. x102 = And x101, x1
104. x103 = And x102, x1
105. x104 = And x103, x1
106. x105 = And x104, x1
107. x106 = And x105, x1
108. x107 = And x106, x1
109. x108 = And x107, x1
110. x109 = And x108, x1
111. x110 = And x109, x1
112. x111 = And x110, x1
113. x112 = And x111, x1
114. x113 = And x112, x1
115. x114 = And x113, x1
116. x115 = And x114, x1
117. x116 = And x115, x1
118. x117 = And x116, x1
119. x118 = And x117, x1
120. x119 = And x118, x1
121. x120 = And x119, x1
122. x121 = And x120, x1
123. x122 = And x121, x1
124. x123 = And x122, x1
125. x124 = And x123, x1
126. x125 = And x124, x1
127. x126 = And x125, x1
128. x127 = And x126, x1
129. x128 = And x127, x1
130. x129 = And x128, x1
131. x130 = And x129, x1
132. x131 = And x130, x1
133. x132 = And x131, x1
134. x133 = And x132, x1
135. x134 = And x133, x1
136. x135 = And x134, x1
137. x136 = And x135, x1
138. x137 = And x136, x1
139. x138 = And x137, x1
140. x139 = And x138, x1
141. x140 = And x139, x1
142. x141 = And x140, x1
143. x142 = And x141, x1
144. x143 = And x142, x1
145. x144 = And x143, x1
146. x145 = And x144, x1
147. x146 = And x145, x1
148. x147 = And x146, x1
149. x148 = And x147, x1
150. x149 = And x148, x1
151. x150 = And x149, x1
152. x151 = And x150, x1
153. x152 = And x151, x1
154. x153 = And x152, x1
155. x154 = And x153, x1
156. x155 = And x154, x1
157. x156 = And x155, x1
158. x157 = And x156, x1
159. x158 = And x157, x1
160. x159 = And x158, x1
161. x160 = And x159, x1
162. x161 = And x160, x1
163. x162 = And x161, x1
164. x163 = And x162, x1
165. x164 = And x163, x1
166. x165 = And x164, x1
167. x166 = And x165, x1
168. x167 = And x166, x1
169. x168 = And x167, x1
170. x169 = And x168, x1
171. x170 = And x169, x1
172. x171 = And x170, x1
173. x172 = And x171, x1
174. x173 = And x172, x1
175. x174 = And x173, x1
176. x175 = And x174, x1
177. x176 = And x175, x1
178. x177 = And x176, x1
179. x178 = And x177, x1
180. x179 = And x178, x1
181. x180 = And x179, x1
182. x181 = And x180, x1
183. x182 = And x181, x1
184. x183 = And x182, x1
185. x184 = And x183, x1
186. x185 = And x184, x1
187. x186 = And x185, x1
188. x187 = And x186, x1
189. x188 = And x187, x1
190. x189 = And x188, x1
191. x190 = And x189, x1
192. x191 = And x190, x1
193. x192 = And x191, x1
194. x193 = And x192, x1
195. x194 = And x193, x1
196. x195 = And x194, x1
197. x196 = And x195, x1
198. x197 = And x196, x1
199. x198 = And x197, x1
200. x199 = And x198, x1
201. x200 = And x199, x1
202. x201 = And x200, x1
203. x202 = And x201, x1
204. x203 = And x202, x1
205. x204 = And x203, x1
206. x205 = And x204, x1
207. x206 = And x205, x1
208. x207 = And x206, x1
209. x208 = And x207, x1
210. x209 = And x208, x1
211. x210 = And x209, x1
212. x211 = And x210, x1
213. x212 = And x211, x1
214. x213 = And x212, x1
215. x214 = And x213, x1
216. x215 = And x214, x1
217. x216 = And x215, x1
218. x217 = And x216, x1
219. x218 = And x217, x1
220. x219 = And x218, x1
221. x220 = And x219, x1
222. x221 = And x220, x1
223. x222 = And x221, x1
224. x223 = And x222, x1
225. x224 = And x223, x1
226. x225 = And x224, x1
227. x226 = And x225, x1
228. x227 = And x226, x1
229. x228 = And x227, x1
230. x229 = And x228, x1
231. x230 = And x229, x1
232. x231 = And x230, x1
233. x232 = And x231, x1
234. x233 = And x232, x1
235. x234 = And x233, x1
236. x235 = And x234, x1
237. x236 = And x235, x1
238. x237 = And x236, x1
239. x238 = And x237, x1
240. x239 = And x238, x1
241. x240 = And x239, x1
242. x241 = And x240, x1
243. x242 = And x241, x1
244. x243 = And x242, x1
245. x244 = And x243, x1
246. x245 = And x244, x1
247. x246 = And x245, x1
248. x247 = And x246, x1
249. x248 = And x247, x1
250. x249 = And x248, x1
251. x250 = And x249, x1
252. x251 = And x250, x1
253. x252 = And x251, x1
254. x253 = And x252, x1
255. x254 = And x253, x1
256. x255 = And x254, x1
257. x256 = And x255, x1
258. x257 = And x256, x1
259. x258 = And x257, x1
260. x259 = And x258, x1
261. x260 = And x259, x1
262. x261 = And x260, x1
263. x262 = And x261, x1
264. x263 = And x262, x1
265. x264 = And x263, x1
266. x265 = And x264, x1
267. x266 = And x265, x1
268. x267 = And x266, x1
269. x268 = And x267, x1
270. x269 = And x268, x1
271. x270 = And x269, x1
272. x271 = And x270, x1
273. x272 = And x271, x1
274. x273 = And x272, x1
275. x274 = And x273, x1
276. x275 = And x274, x1
277. x276 = And x275, x1
278. x277 = And x276, x1
279. x278 = And x277, x1
280. x279 = And x278, x1
281. x280 = And x279, x1
282. x281 = And x280, x1
283. x282 = And x281, x1
284. x283 = And x282, x1
285. x284 = And x283, x1
286. x285 = And x284, x1
287. x286 = And x285, x1
288. x287 = And x286, x1
289. x288 = And x287, x1
290. x289 = And x288, x1
291. x290 = And x289, x1
292. x291 = And x290, x1
293. x292 = And x291, x1
294. x293 = And x292, x1
295. x294 = And x293, x1
296. x295 = And x294, x1
297. x296 = And x295, x1
298. x297 = And x296, x1
299. x298 = And x297, x1
300. x299 = And x298, x1
301. x300 = And x299, x1
302. x301 = And x300, x1
303. x302 = And x301, x1
304. x303 = And x302, x1
305. x304 = And x303, x1
306. x305 = And x304, x1
307. x306 = And x305, x1
308. x307 = And x306, x1
309. x308 = And x307, x1
310. x309 = And x308, x1
311. x310 = And x309, x1
312. x311 = And x310, x1
313. x312 = And x311, x1
314. x313 = And x312, x1
315. x314 = And x313, x1
316. x315 = And x314, x1
317. x316 = And x315, x1
318. x317 = And x316, x1
319. x318 = And x317, x1
320. x319 = And x318, x1
321. x320 = And x319, x1
322. x321 = And x320, x1
323. x322 = And x321, x1
324. x323 = And x322, x1
325. x324 = And x323, x1
326. x325 = And x324, x1
327. x326 = And x325, x1
328. x327 = And x326, x1
329. x328 = And x327, x1
330. x329 = And x328, x1
331. x330 = And x329, x1
332. x331 = And x330, x1
333. x332 = And x331, x1
334. x333 = And x332, x1
335. x334 = And x333, x1
336. x335 = And x334, x1
337. x336 = And x335, x1
338. x337 = And x336, x1
339. x338 = And x337, x1
340. x339 = And x338, x1
341. x340 = And x339, x1
342. x341 = And x340, x1
343. x342 = And x341, x1
344. x343 = And x342, x1
345. x344 = And x343, x1
346. x345 = And x344, x1
347. x346 = And x345, x1
348. x347 = And x346, x1
349. x348 = And x347, x1
350. x349 = And x348, x1
351. x350 = And x349, x1
352. x351 = And x350, x1
353. x352 = And x351, x1
354. x353 = And x352, x1
355. x354 = And x353, x1
356. x355 = And x354, x1
357. x356 = And x355, x1
358. x357 = And x356, x1
359. x358 = And x357, x1
360. x359 = And x358, x1
361. x360 = And x359, x1
362. x361 = And x360, x1
363. x362 = And x361, x1
364. x363 = And x362, x1
365. x364 = And x363, x1
366. x365 = And x364, x1
367. x366 = And x365, x1
368. x367 = And x366, x1
369. x368 = And x367, x1
370. x369 = And x368, x1
371. x370 = And x369, x1
372. x371 = And x370, x1
373. x372 = And x371, x1
374. x373 = And x372, x1
375. x374 = And x373, x1
376. x375 = And x374, x1
377. x376 = And x375, x1
378. x377 = And x376, x1
379. x378 = And x377, x1
380. x379 = And x378, x1
381. x380 = And x379, x1
382. x381 = And x380, x1
383. x382 = And x381, x1
384. x383 = And x382, x1
385. x384 = And x383, x1
386. x385 = And x384, x1
387. x386 = And x385, x1
388. x387 = And x386, x1
389. x388 = And x387, x1
390. x389 = And x388, x1
391. x390 = And x389, x1
392. x391 = And x390, x1
393. x392 = And x391, x1
394. x393 = And x392, x1
395. x394 = And x393, x1
396. x395 = And x394, x1
397. x396 = And x395, x1
398. x397 = And x396, x1
399. x398 = And x397, x1
400. x399 = And x398, x1
401. x400 = And x399, x1
402. x401 = And x400, x1
403. x402 = And x401, x1
404. x403 = And x402, x1
405. x404 = And x403, x1
406. x405 = And x404, x1
407. x406 = And x405, x1
408. x407 = And x406, x1
409. x408 = And x407, x1
410. x409 = And x408, x1
411. x410 = And x409, x1
412. x411 = And x410, x1
413. x412 = And x411, x1
414. x413 = And x412, x1
415. x414 = And x413, x1
416. x415 = And x414, x1
417. x416 = And x415, x1
418. x417 = And x416, x1
419. x418 = And x417, x1
420. x419 = And x418, x1
421. x420 = And x419, x1
422. x421 = And x420, x1
423. x422 = And x421, x1
424. x423 = And x422, x1
425. x424 = And x423, x1
426. x425 = And x424, x1
427. x426 = And x425, x1
428. x427 = And x426, x1
429. x428 = And x427, x1
430. x429 = And x428, x1
431. x430 = And x429, x1
432. x431 = And x430, x1
433. x432 = And x431, x1
434. x433 = And x432, x1
435. x434 = And x433, x1
436. x435 = And x434, x1
437. x436 = And x435, x1
438. x437 = And x436, x1
439. x438 = And x437, x1
440. x439 = And x438, x1
441. x440 = And x439, x1
442. x441 = And x440, x1
443. x442 = And x441, x1
444. x443 = And x442, x1
445. x444 = And x443, x1
446. x445 = And x444, x1
447. x446 = And x445, x1
448. x447 = And x446, x1
449. x448 = And x447, x1
450. x449 = And x448, x1
451. x450 = And x449, x1
452. x451 = And x450, x1
453. x452 = And x451, x1
454. x453 = And x452, x1
455. x454 = And x453, x1
456. x455 = And x454, x1
457. x456 = And x455, x1
458. x457 = And x456, x1
459. x458 = And x457, x1
460. x459 = And x458, x1
461. x460 = And x459, x1
462. x461 = And x460, x1
463. x462 = And x461, x1
464. x463 = And x462, x1
465. x464 = And x463, x1
466. x465 = And x464, x1
467. x466 = And x465, x1
468. x467 = And x466, x1
469. x468 = And x467, x1
470. x469 = And x468, x1
471. x470 = And x469, x1
472. x471 = And x470, x1
473. x472 = And x471, x1
474. x473 = And x472, x1
475. x474 = And x473, x1
476. x475 = And x474, x1
477. x476 = And x475, x1
478. x477 = And x476, x1
479. x478 = And x477, x1
480. x479 = And x478, x1
481. x480 = And x4