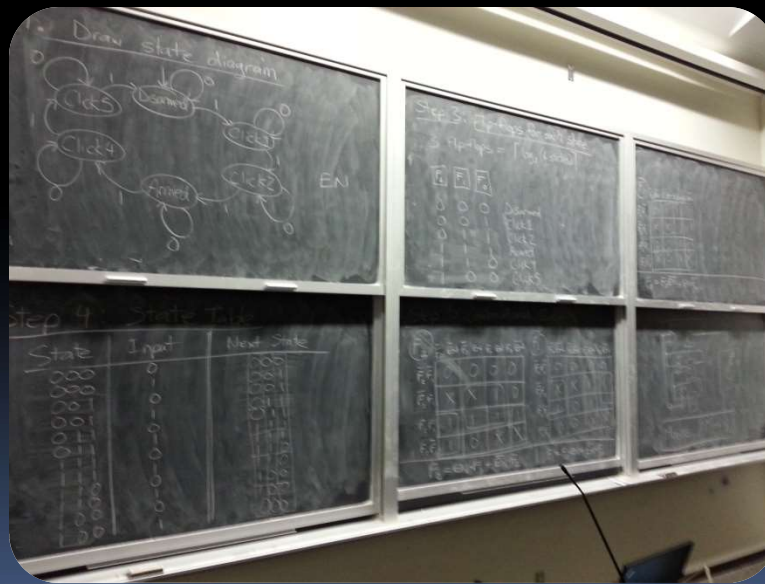


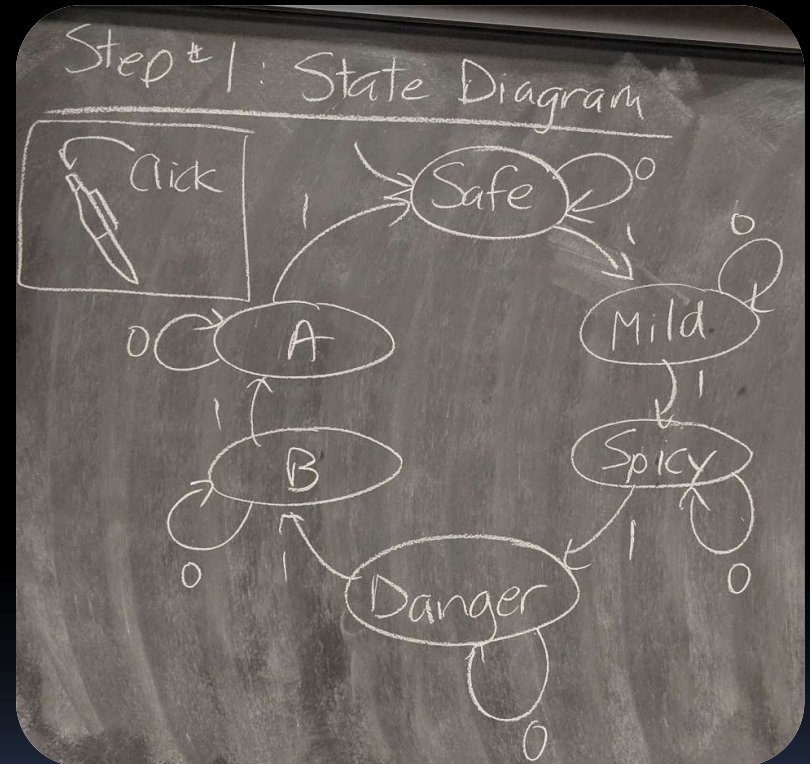
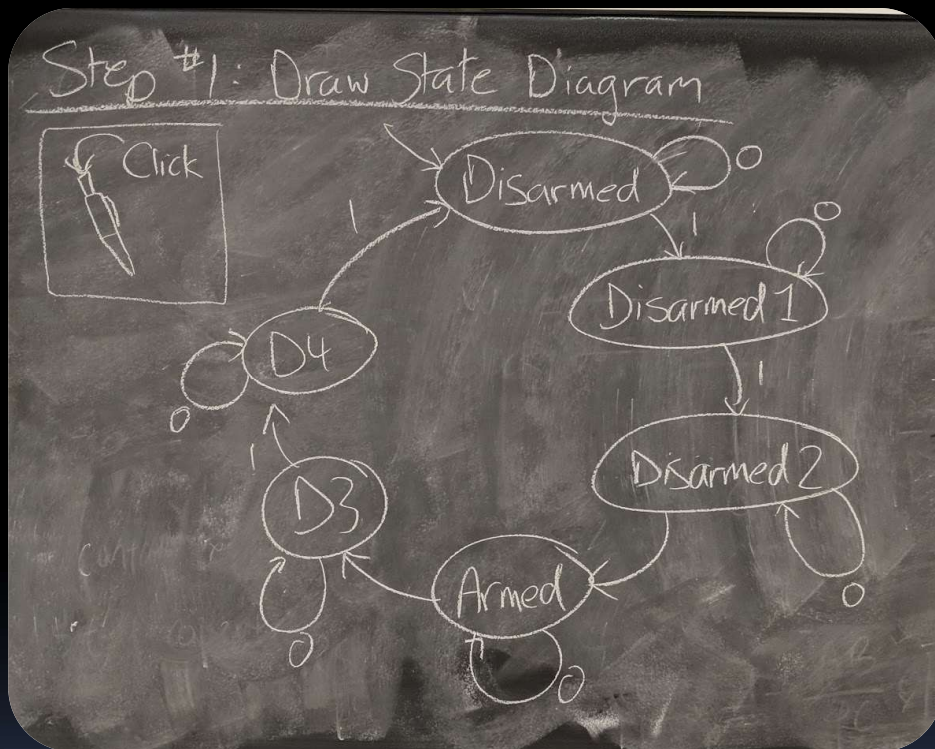
FSM example - Winter 2019



FSM task

- Exploding pen from Goldeneye (James Bond)
 - Three clicks to arm,
 - Three clicks to disarm.
- Note how the design differs as a result of choosing different flip-flop assignments!

Step 1: State Diagram



Step 2: State Table

Step #2: State Table

Starting State	Click	Next State
Disarmed	0	Disarmed
Disarmed	1	Disarmed 1
Disarmed 1	0	Disarmed 1
Disarmed 1	1	Disarmed 2
Disarmed 2	0	Disarmed 2
Disarmed 2	1	Armed
Armed	0	Armed
Armed	1	D3
D3	0	D3
D3	1	D4
D4	0	D4
D4	1	Disarmed

Step #2: State Table

Start State	Click	Next State
Safe	0	Safe
Safe	1	Mild
Mild	0	Mild
Mild	1	Spicy
Spicy	0	Spicy
Spicy	1	Danger
Danger	0	Danger
Danger	1	B
B	0	B
B	1	A
A	0	A
A	1	Safe

Step 3: Flip Flop Assignments

Step #3: Flip-Flop Assignments

State

Flip-Flop Values

Disarmed

F_2 F_1 F_0
0 0 0

Disarmed 1

0 0 1

Disarmed 2

0 1 1

Armed

1 1 1

D3

1 1 0

D4

1 0 0

Step #3: Flip-Flop Assignments

State

Flip-Flops

F_2 F_1 F_0

Safe

0 0 0

Mild

0 0 1

Spicy

0 1 1

Danger

1 1 1

B

1 1 0

A

1 0 0

Step 4: State Table, updated

Step #4: State Table

Starting State	Click	Next State
0	0	0
0	1	0
0	2	0
0	3	0
0	4	0
0	5	0
0	6	0
0	7	0
0	8	0
0	9	0
0	10	0
0	11	0
0	12	0
0	13	0
0	14	0
0	15	0
0	16	0
0	17	0
0	18	0
0	19	0
0	20	0
0	21	0
0	22	0
0	23	0
0	24	0
0	25	0
0	26	0
0	27	0
0	28	0
0	29	0
0	30	0
0	31	0
0	32	0
0	33	0
0	34	0
0	35	0
0	36	0
0	37	0
0	38	0
0	39	0
0	40	0
0	41	0
0	42	0
0	43	0
0	44	0
0	45	0
0	46	0
0	47	0
0	48	0
0	49	0
0	50	0
0	51	0
0	52	0
0	53	0
0	54	0
0	55	0
0	56	0
0	57	0
0	58	0
0	59	0
0	60	0
0	61	0
0	62	0
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0	64	0
0	65	0
0	66	0
0	67	0
0	68	0
0	69	0
0	70	0
0	71	0
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0	73	0
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0	108	0
0	109	0
0	110	0
0	111	0
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0	116	0
0	117	0
0	118	0
0	119	0
0	120	0
0	121	0
0	122	0
0	123	0
0	124	0
0	125	0
0	126	0
0	127	0
0	128	0
0	129	0
0	130	0
0	131	0
0	132	0
0	133	0
0	134	0
0	135	0
0	136	0
0	137	0
0	138	0
0	139	0
0	140	0
0	141	0
0	142	0
0	143	0
0	144	0
0	145	0
0	146	0
0	147	0
0	148	0
0	149	0
0	150	0
0	151	0
0	152	0
0	153	0
0	154	0
0	155	0
0	156	0
0	157	0
0	158	0
0	159	0
0	160	0
0	161	0
0	162	0
0	163	0
0	164	0
0	165	0
0	166	0
0	167	0
0	168	0
0	169	0
0	170	0
0	171	0
0	172	0
0	173	0
0	174	0
0	175	0
0	176	0
0	177	0
0	178	0
0	179	0
0	180	0
0	181	0
0	182	0
0	183	0
0	184	0
0	185	0
0	186	0
0	187	0
0	188	0
0	189	0
0	190	0
0	191	0
0	192	0
0	193	0
0	194	0
0	195	0
0	196	0
0	197	0
0	198	0
0	199	0
0	200	0
0	201	0
0	202	0
0	203	0
0	204	0
0	205	0
0	206	0
0	207	0
0	208	0
0	209	0
0	210	0
0	211	0
0	212	0
0	213	0
0	214	0
0	215	0
0	216	0
0	217	0
0	218	0
0	219	0
0	220	0
0	221	0
0	222	0
0	223	0
0	224	0
0	225	0
0	226	0
0	227	0
0	228	0
0	229	0
0	230	0
0	231	0
0	232	0
0	233	0
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0	235	0
0	236	0
0	237	0
0	238	0
0	239	0
0	240	0
0	241	0
0	242	0
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0	244	0
0	245	0
0	246	0
0	247	0
0	248	0
0	249	0
0	250	0
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0	252	0
0	253	0
0	254	0
0	255	0
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0	257	0
0	258	0
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0	262	0
0	263	0
0	264	0
0	265	0
0	266	0
0	267	0
0	268	0
0	269	0
0	270	0
0	271	0
0	272	0
0	273	0
0	274	0
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0	277	0
0	278	0
0	279	0
0	280	0
0	281	0
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0	283	0
0	284	0
0	285	0
0	286	0
0	287	0
0	288	0
0	289	0
0	290	0
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0	292	0
0	293	0
0	294	0
0	295	0
0	296	0
0	297	0
0	298	0
0	299	0
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0	302	0
0	303	0
0	304	0
0	305	0
0	306	0
0	307	0
0	308	0
0	309	0
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0	311	0
0	312	0
0	313	0
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0	321	0
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0	329	0
0	330	0
0	331	0
0	332	0
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0	334	0
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0	337	0
0	338	0
0	339	0
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0	343	0
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0	346	0
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0	356	0
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0	373	0
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0	377	0
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0	379	0
0	380	0
0	381	0
0	382	0
0	383	0
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0	390	0
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0	407	0
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0	411	0
0	412	0
0	413	0
0	414	0
0	415	0
0	416	0
0	417	0
0	418	0
0	419	0
0	420	0
0	421	0
0	422	0
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0	424	0
0	425	0
0	426	0
0	427	0
0	428	0
0	429	0
0	430	0
0	431	0
0	432	0
0	433	0
0	434	0
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0	457	0
0	458	0
0	459	0
0	460	0
0	461	0
0	462	0
0	463	0
0	464	0
0	465	0
0	466	0
0	467	0
0	468	0
0	469	0
0	470	0
0	471	0
0	472	0
0	473	0
0	474	0
0	475	0

Step 5: Circuit Design

F_2'

	$\bar{F}_0 \text{Click}$	$\bar{F}_0 \text{Click}$	$F_0 \text{Click}$	$F_0 \text{Click}$
$\bar{F}_2 \bar{F}_1$	0	0	0	0
$\bar{F}_2 F_1$	X	X	1	0
$F_2 \bar{F}_1$	1	1	1	1
$F_2 F_1$	1	0	X	X

$$F_2' = F_1 \text{Click} + F_2 \text{Click}$$

F_2'

	$\bar{F}_0 \text{Click}$	$\bar{F}_0 \text{Click}$	$F_0 \text{Click}$	$F_0 \text{Click}$
$\bar{F}_2 \bar{F}_1$	0	0	0	0
$\bar{F}_2 F_1$	X	X	1	0
$F_2 \bar{F}_1$	1	1	1	1
$F_2 F_1$	1	0	X	X

$$F_2' = F_1 \text{Click} + F_2 \text{Click}$$

F_1'

	$\bar{F}_0 \text{Click}$	$\bar{F}_0 \text{Click}$	$F_0 \text{Click}$	$F_0 \text{Click}$
$\bar{F}_2 \bar{F}_1$	0	0	1	0
$\bar{F}_2 F_1$	X	X	1	1
$F_2 \bar{F}_1$	1	0	1	1
$F_2 F_1$	0	0	X	X

$$F_1' = F_0 \text{Click} + F_1 \text{Click}$$

F_1'

	$\bar{F}_0 \text{Click}$	$\bar{F}_0 \text{Click}$	$F_0 \text{Click}$	$F_0 \text{Click}$
$\bar{F}_2 \bar{F}_1$	0	0	1	0
$\bar{F}_2 F_1$	X	X	1	1
$F_2 \bar{F}_1$	1	0	1	1
$F_2 F_1$	0	0	X	X

$$F_1' = F_0 \text{Click} + F_1 \text{Click}$$

Step 5: Circuit Design

F_0'

	$\bar{F}_0 \text{Click}$	$\bar{F}_0 \text{Click}$	$F_0 \text{Click}$	$F_0 \text{Click}$
$\bar{F}_2 \bar{F}_1$	0	1	1	1
$\bar{F}_2 F_1$	X	X	1	1
$F_2 \bar{F}_1$	0	0	0	1
$F_2 F_1$	0	0	X	X

$F_0' = \bar{F}_2 \text{Click} + F_0 \text{Click}$

F_0'

	$\bar{F}_0 \text{Click}$	$\bar{F}_0 \text{Click}$	$F_0 \text{Click}$	$F_0 \text{Click}$
$\bar{F}_2 \bar{F}_1$	0	1	1	1
$\bar{F}_2 F_1$	X	X	1	1
$F_2 \bar{F}_1$	0	0	0	1
$F_2 F_1$	0	0	X	X

$F_0' = \bar{F}_2 \text{Click} + F_0 \text{Click}$

Step 5: Circuit Design

