1 Q1

We have derived the following equations from the graph:

$$\begin{aligned}
p_{\mathrm{A}} &= 0.8p_{\mathrm{H}} \\
p_{\mathrm{B}} &= 0.7p_{\mathrm{A}} + 0.5p_{\mathrm{E}} \\
p_{\mathrm{C}} &= 0.7p_{\mathrm{D}} + p_{\mathrm{B}} \\
p_{\mathrm{D}} &= 0.5p_{\mathrm{E}} \\
p_{\mathrm{E}} &= 0.3p_{\mathrm{A}} \\
p_{\mathrm{F}} &= 0.6p_{\mathrm{C}} \\
p_{\mathrm{G}} &= 0.2p_{\mathrm{H}} + 0.4p_{\mathrm{C}} + p_{\mathrm{F}} \\
p_{\mathrm{H}} &= p_{\mathrm{G}} + 0.3p_{\mathrm{D}} \\
1 &= p_{\mathrm{A}} + p_{\mathrm{B}} + p_{\mathrm{C}} + p_{\mathrm{D}} + p_{\mathrm{E}} + p_{\mathrm{F}} + p_{\mathrm{G}} + p_{\mathrm{H}}
\end{aligned}$$

Solving these equations gets us the following values:

$$\begin{aligned}
p_{\mathrm{A}} &= 0.1592 \\
p_{\mathrm{B}} &= 0.1353 \\
p_{\mathrm{C}} &= 0.1520 \\
p_{\mathrm{D}} &= 0.0239 \\
p_{\mathrm{E}} &= 0.0477 \\
p_{\mathrm{F}} &= 0.0912 \\
p_{\mathrm{G}} &= 0.1918 \\
p_{\mathrm{H}} &= 0.0199
\end{aligned}$$

The order that the states should be tested in is

$$H \to G \to A \to C \to B \to F \to E \to D$$

2 Q2

For unknown relationships:

$$\begin{aligned}
\#\text{ of test cases} &= |A| \times |B| \times |C| \times |D| \times |E| \times |F| \\
&= 5 \times 5 \times 3 \times 5 \times 2 \times 3 \\
&= 2250
\end{aligned}$$

Knowing the following functional relationships,

$$\begin{aligned} x &= A \times D \times E \\ &= 5 \times 5 \times 2 \\ &= 50 \end{aligned}$$

$$\begin{aligned} y &= B \\ &= 5 \end{aligned}$$

$$\begin{aligned} z &= C \times F \\ &= 3 \times 3 \\ &= 9 \end{aligned}$$

the upper bound of the number of test cases is:

$$\begin{aligned} \#\text{ of test cases} &= x + y + z \\ &= 50 + 5 + 9 \\ &= 64 \end{aligned}$$

The following tables are an example set of test cases. Note that every test case requires a value for A, B, C, D, E, F. If a value is not provided for a variable in the proposed test case below, it means that any of the possible values may be selected.

Table 1: Test cases for x

Test #	A	D	E	Test #	A	D	E	Test #	A	D	E
1	0	7	Y	18	1	10	N	35	3	9	Y
2	0	7	N	19	1	11	Y	36	3	9	N
3	0	8	Y	20	1	11	N	37	3	10	Y
4	0	8	N	21	2	7	Y	38	3	10	N
5	0	9	Y	22	2	7	N	39	3	11	Y
6	0	9	N	23	2	8	Y	40	3	11	N
7	0	10	Y	24	2	8	N	41	4	7	Y
8	0	10	N	25	2	9	Y	42	4	7	N
9	0	11	Y	26	2	9	N	43	4	8	Y
10	0	11	N	27	2	10	Y	44	4	8	N
11	1	7	Y	28	2	10	N	45	4	9	Y
12	1	7	N	29	2	11	Y	46	4	9	N
13	1	8	Y	30	2	11	N	47	4	10	Y
14	1	8	N	31	3	7	Y	48	4	10	N
15	1	9	Y	32	3	7	N	49	4	11	Y
16	1	9	N	33	3	8	Y	50	4	11	N
17	1	10	Y	34	3	8	N				

Table 2: Test cases for y

Test #	B
51	A
52	B
53	C
54	D
55	E

Table 3: Test cases for z

Test #	C	F
56	100	α
57	100	β
58	100	γ
59	200	α
60	200	β
61	200	γ
62	300	α
63	300	β
64	300	γ

3 Q3

For simplicity, we will simplify the following keywords:

- HARDKEYBOARDHIDDEN = HKH
- KEYBOARDHIDDEN = KH
- KEYBOARD = K
- NAVIGATIONHIDDEN = NH
- NAVIGATION = N
- ORIENTATION = O
- SCREENLAYOUT_LONG = SLL
- SCREENLAYOUT_SIZE = SLS
- TOUCHSCREEN = T
- UNDEFINED = N/A
- LANDSCAPE = LSP
- QWERTY = Q
- NOTOUCH = NT
- PORTRAIT = P
- TRACKBALL = TB

Table 4: Results using pairwise testing

#	HKH	KH	K	NH	N	O	SLL	SLS	T
1	NO	NO	12KEY	NO	DPAD	LSP	MASK	LRG	FNGR
2	N/A	N/A	NOKEYS	N/A	NONAV	P	NO	MASK	FNGR
3	YES	YES	Q	YES	TB	SQR	N/A	NORM	FNGR
4	YES	N/A	N/A	NO	N/A	N/A	YES	SML	NT
5	N/A	NO	N/A	YES	WHEEL	N/A	N/A	N/A	STYLUS
6	NO	YES	NOKEYS	N/A	WHEEL	SQR	YES	N/A	N/A
7	NO	N/A	Q	YES	N/A	LSP	NO	LRG	N/A
8	N/A	YES	12KEY	NO	NONAV	SQR	MASK	SML	STYLUS
9	YES	NO	NOKEYS	N/A	TB	LSP	MASK	MASK	NT
10	NO	NO	Q	NO	NONAV	P	YES	NORM	NT
11	YES	YES	12KEY	YES	DPAD	P	NO	N/A	NT
12	N/A	N/A	12KEY	N/A	DPAD	N/A	N/A	NORM	N/A
13	N/A	N/A	Q	N/A	WHEEL	LSP	MASK	SML	STYLUS
14	NO	YES	N/A	N/A	N/A	P	N/A	LRG	STYLUS
15	N/A	NO	N/A	NO	TB	SQR	NO	SML	N/A
16	YES	YES	NOKEYS	YES	NONAV	N/A	N/A	MASK	N/A
17	N/A	N/A	NOKEYS	NO	N/A	SQR	YES	LRG	NT

18	NO	N/A	N/A	NO	TB	N/A	MASK	N/A	FNGR
19	YES	YES	N/A	NO	WHEEL	LSP	N/A	NORM	NT
20	YES	NO	12KEY	YES	N/A	P	MASK	NORM	N/A
21	YES	YES	12KEY	YES	WHEEL	P	YES	MASK	STYLUS
22	NO	YES	NOKEYS	NO	DPAD	SQR	YES	MASK	STYLUS
23	YES	YES	Q	YES	DPAD	N/A	NO	SML	STYLUS
24	YES	YES	N/A	NO	NONAV	LSP	YES	N/A	FNGR
25	YES	YES	N/A	NO	DPAD	N/A	N/A	LRG	STYLUS
26	NO	YES	NOKEYS	NO	TB	P	YES	SML	STYLUS
27	YES	YES	Q	NO	WHEEL	P	NO	NORM	STYLUS
28	YES	YES	Q	NO	N/A	P	N/A	N/A	FNGR
29	YES	YES	N/A	NO	WHEEL	P	N/A	SML	FNGR
30	YES	YES	N/A	NO	WHEEL	P	N/A	MASK	STYLUS
31	YES	YES	Q	NO	WHEEL	P	N/A	MASK	STYLUS
32	YES	YES	NOKEYS	NO	WHEEL	P	N/A	NORM	STYLUS
33	YES	YES	12KEY	NO	TB	P	N/A	LRG	STYLUS
34	YES	YES	N/A	NO	WHEEL	P	N/A	LRG	STYLUS
35	YES	YES	N/A	NO	N/A	P	N/A	MASK	STYLUS
36	YES	YES	N/A	NO	NONAV	P	N/A	LRG	STYLUS

There are 36 tests using pairwise testing. This is significantly less than the 172800 tests when considering all combinations.

To calculate the number of tests required to consider all combinations of input values, we need to perform the following calculation:

$$\begin{aligned} \#\text{ of tests} &= 3 \times 3 \times 4 \times 3 \times 5 \times 4 \times 4 \times 5 \times 4 \\ &= 172800 \end{aligned}$$

4 Q4

For terminal symbol coverage:

$$\begin{aligned} \#\text{ of tests} &= \#\text{ of ops} + \#\text{ of letters} + \#\text{ of digits} \\ &= 4 + 52 + 10 \\ &= 66 \end{aligned}$$

For production coverage:

$$\begin{aligned} \#\text{ of tests} &= \#\text{ of expr possibilities} + \#\text{ of id possibilities} \\ &\quad + \#\text{ of num possibilities} + \#\text{ of symbol possibilities} \\ &= 3 + 2 + 2 + 66 \\ &= 73 \end{aligned}$$

For derivation coverage, there are an infinite amount of tests because of the first expr rule

Table 5: Possible test cases

Test #	Test case
1	a
3	ab
4	6
5	67
6	A+4
7	AB + 47
8	A + 47
7	B + 7