Coverage and Usage Testing

Based on FSMs and Markov Chains

FSM-Based Testing

FSM:

- State: operations/ functions

- Transition: link int a chain

- Input/output associated with transition

- Complete operation: chain

Three representations of FSMs

- Graphical

- Tabular

- list

1. define state

   {Power-Up, Mobile Station Initialization, Mobile Station Idle, System access, Mobile station control or Traffic channel}

   {A, B, C, D, E}

2. define transitions

   {A -> B; B-> C; C->D (paging channel message); C-> B (unable to receive paging channel); D->C (finished other tasks); D -> E (making a call); E -> B}
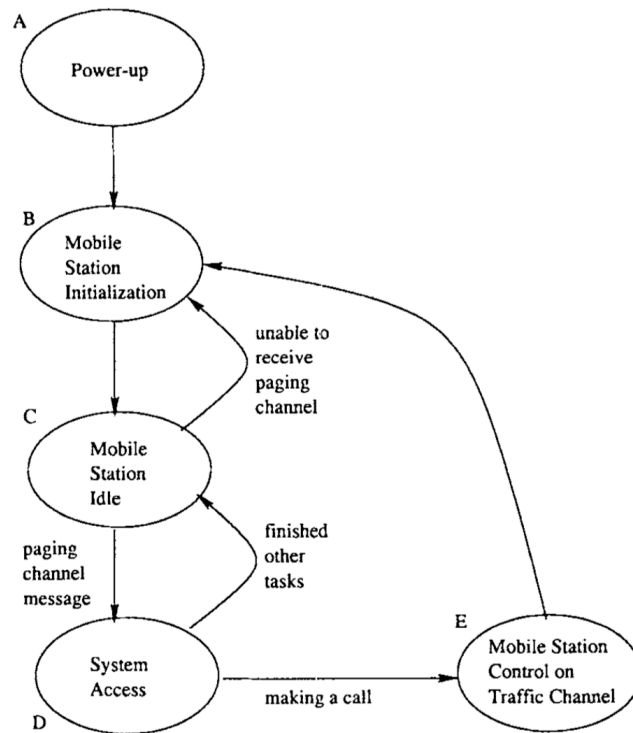
Graphical

Figure 10.1 An example finite-state machine (FSM) for call processing

Tabular

1. define row and col meaning

   The rows represent originating states and the columns represent ending states for specific transitions.

2. define cell

   A null input or a null output is marked by "-".

   msg , NoC , call, and done to represent "paging channel message", "unable to receive paging channel", "making a call", and "finished with other tasks", respectively.

   "na" or not marked (left empty), the corresponding transition is not allowed.

Table 10.1 An example finite-state machine (FSM) for call processing in tabular representation

	A	B	C	D	E
A	na	-/-	na	na	na
B	na	na	-/-	na	na
C	na	NoC/-	na	msg/-	na
D	na	na	done/-	na	call/-
E	na	-/-	na	na	na

List

{A, B, - , -}

{B, C, -, -}

{C, B, "unable to receive paging channel", -}

{C, D, "paging channel message", -}

{D, C, "finished with other tasks", -}

{D, E, "making a call", -}

{E, B, -, -}

Markov Chains as Enhanced FSMs

FSM+发生的概率 = Markov Chains

In the context that we use it for usage-based statistical testing, this Markov chain is also called a Markov OP, because it constitutes the specific operational profile (OP) for the system.

Musa's operational profiles (OPs) for usage-based statistical testing using partitions.
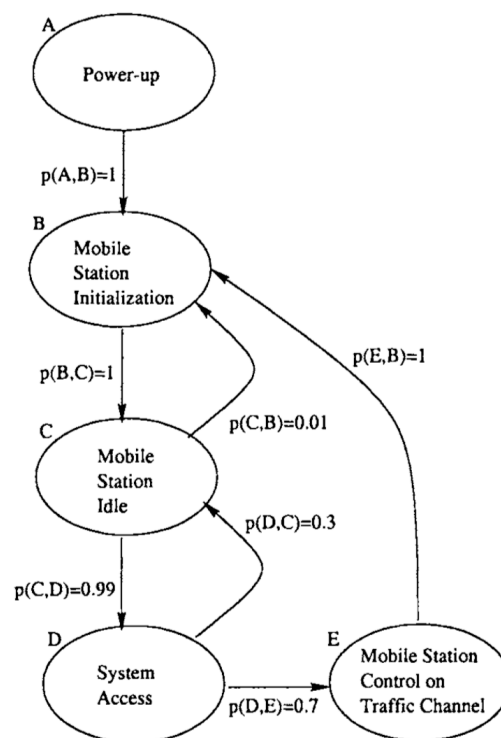

Figure 10.3 Example Markov chain for call processing FSM in Figure 10.1

Starting with a simple Markov OP example of your choice, convert it to the corresponding Musa OP. (Make necessary assumptions as needed.)

output sum should be 1

Musa OP: an operational profile, or an OP for short, is a list of disjoint set of operations and their associated probabilities of occurrence.
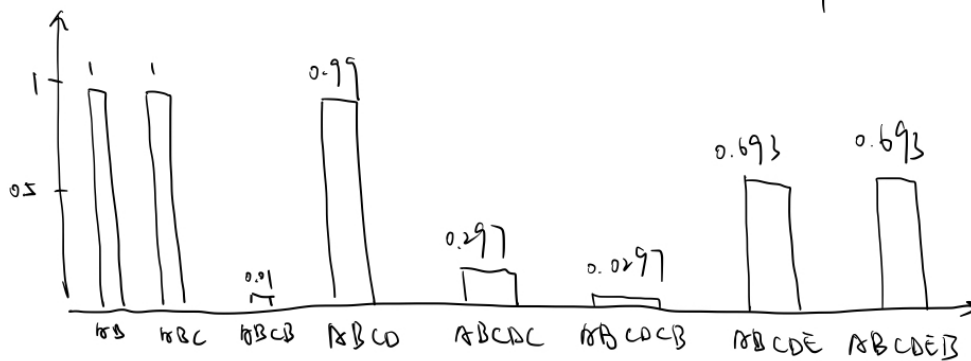
$AB = 1$

$ABC = 1$

$ABCB = 1 \times 0.01 = 0.01$

$ABCD = 1 \times 1 \times 0.99 = 0.99$

$ABCDC = 1 \times 1 \times 0.99 \times 0.3 = 0.297$

$ABCDCB = 1 \times 1 \times 0.99 \times 0.3 \times 0.01 = 0.0297$

$ABCDE = 1 \times 1 \times 0.99 \times 0.7 = 0.693$

$ABCDEB = 1 \times 1 \times 0.99 \times 0.7 \times 1 = 0.693$

Unified Markov Models for Testing
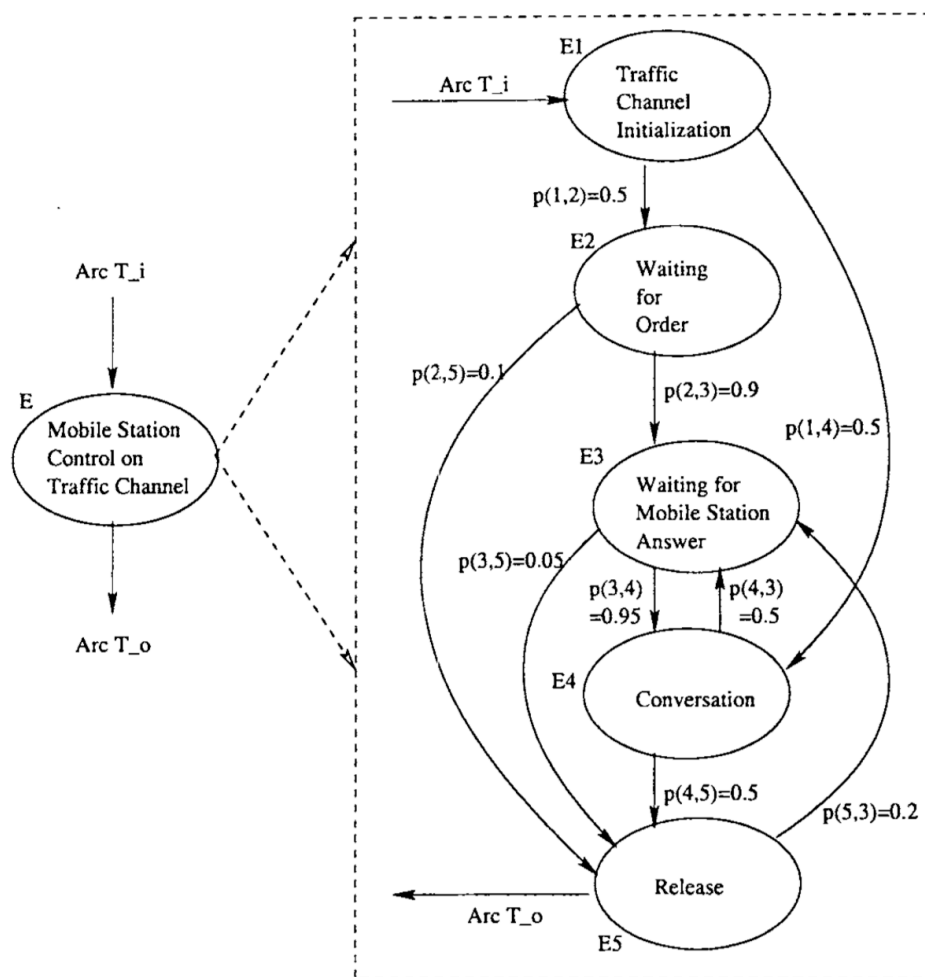
统一马尔可夫模型

Figure 10.4   Example UMM (unified Markov model): Expanding state E of the top-level UMM in Figure 10.3 into a lower-level UMM

这样的 UMMs 使得模拟个别操作单元并将它们链接起来形成全局操作变得简单。更高层次的操作可以扩展到更低层次的模型中，以进行更彻底的测试。

Table 10.2 Top entry pages to SMU/SEAS

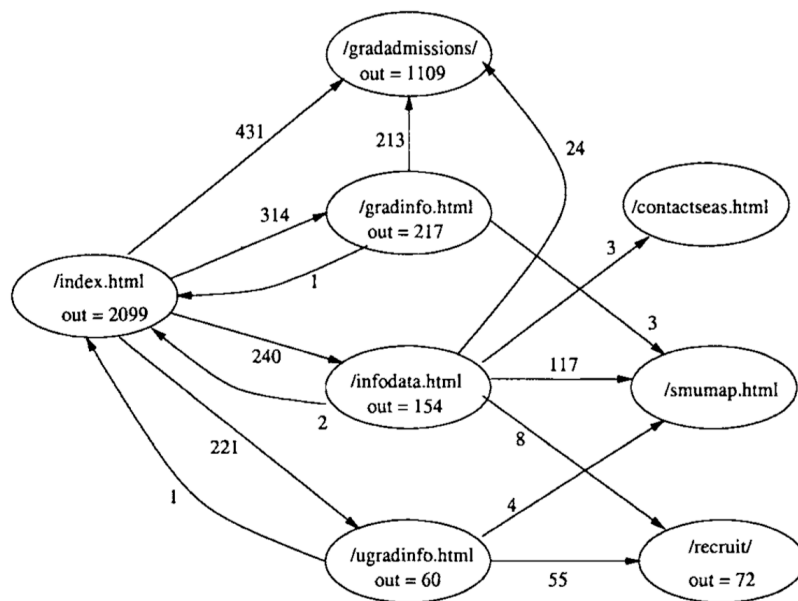| Entry Page	Occurrences
/index.html	18646
/ce/index.html	2778
/co/cams/index.html	2568
/ce/smu/index.html	2327
/netech/index.html	2139
/disted/phd/index.html	1036
/co/cams/clemscam.html	963
/disted/index.html	878
/cse/index.html	813

Figure 10.6 Top-level UMM for SMU/SEAS