Outline for January 30, 2012

Reading: §5.2.3–5.2.4

1. Bell-LaPadula: formal model
   a. Elements of system: s_i subjects, o_i objects
   b. State space $V = B \times M \times F \times H$ where:
      B set of current accesses (i.e., access modes each subject has currently to each object);
      M access permission matrix;
      F consists of 3 functions: f_s is security level associated with each subject, f_o security level associated with each object, and f_c current security level for each subject;
      H hierarchy of system objects, functions $h : O \to \mathcal{P}(O)$ with two properties:
      i. If $o_i \neq o_j$, then $h(o_i) \cap h(o_j) = \varnothing$
      ii. There is no set $\{o_1, \ldots, o_k\} \subseteq O$ such that for each i, $o_{i+1} \in h(o_i)$ and $o_{k+1} = o_1$.
   c. Set of requests is R
   d. Set of decisions is D
   e. $W \subseteq R \times D \times V \times V$ is motion from one state to another.
   f. System $\Sigma(R, D, W, z_0) \subseteq X \times Y \times Z$ such that $(x, y, z) \in \Sigma(R, D, W, z_0)$ iff $(x_t, y_t, z_t, z_{t-1}) \in W$ for each $t \in T$; latter is an action of system
   g. Theorem: $\Sigma(R, D, W, z_0)$ satisfies the simple security condition for any initial state z_0 that satisfies the simple security condition iff W satisfies the following conditions for each action $(r_i, d_i, (b', m', f', h'), (b, m, f, h))$:
      i. each $(s, o, x) \in b' - b$ satisfies the simple security condition relative to f' (i.e., x is not read, or x is read and $f_s(s)$ *dom* $f_o(o)$); and
      ii. if $(s, o, x) \in b$ does not satisfy the simple security condition relative to f', then $(s, o, x) \notin b'$
   h. Theorem: $\Sigma(R, D, W, z_0)$ satisfies the *-property relative to $S' \subseteq S$ for any initial state z_0 that satisfies the *-property relative to S' iff W satisfies the following conditions for each $(r_i, d_i, (b', m', f', h'), (b, m, f, h))$:
      i. for each $s \in S'$, any $(s, o, x) \in b' - b$ satisfies the *-property with respect to f'; and
      ii. for each $s \in S'$, if $(s, o, x) \in b$ does not satisfy the *-property with respect to f', then $(s, o, x) \notin b'$
   i. Theorem: $\Sigma(R, D, W, z_0)$ satisfies the ds-property iff the initial state z_0 satisfies the ds-property and W satisfies the following conditions for each $(r_i, d_i, (b', m', f', h'), (b, m, f, h))$:
      i. if $(s, o, x) \in b' - b$, then $x \in m'[s, o]$; and
      ii. if $(s, o, x) \in b$ and $x \in m'[s, o]$,then $(s, o, x) \notin b'$
   j. Basic Security Theorem: A system $\Sigma(R, D, W, z_0)$ is secure iff z_0 is a secure state and W satisfies the conditions of the above three theorems for each action.