User's View of a Program

**Segmentation**
- Memory-management scheme that supports user view of memory
- A program is a collection of segments. A segment is a logical unit such as:
  - main program
  - procedure
  - function
  - method
  - object
  - local variables, global variables
  - common block,

**Segmentation Architecture**
- Logical address consists of a two tuple: `<segment-number, offset>`,
- **Segment table** - maps two-dimensional physical addresses; each table entry has:
  - base - contains the starting physical address where the segments reside in memory
  - limit - specifies the length of the segment
- **Segment-table base register (STBR)** points to the segment table's location in memory
- **Segment-table length register (STLR)** indicates number of segments used by a program;
Segmentation Architecture (Cont.)

- **Protection.** With each entry in segment table associate:
  - validation bit = 0 → illegal segment
  - read/write/execute privileges
- Protection bits associated with segments; code sharing occurs at segment level
- Since segments vary in length, memory allocation is a dynamic storage-allocation problem
- A segmentation example is shown in the following diagram

Address Translation Architecture

Example of Segmentation

Exercise

* Consider the following segment table:

<table>
<thead>
<tr>
<th>Segment</th>
<th>Base</th>
<th>Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>219</td>
<td>660</td>
</tr>
<tr>
<td>1</td>
<td>2300</td>
<td>14</td>
</tr>
<tr>
<td>2</td>
<td>90</td>
<td>100</td>
</tr>
<tr>
<td>3</td>
<td>1327</td>
<td>580</td>
</tr>
<tr>
<td>4</td>
<td>1952</td>
<td>96</td>
</tr>
</tbody>
</table>

What are the physical addresses for the following logical addresses?

- a. 1, 100
- b. 2, 0
- c. 3, 580

Solution

* Consider the following segment table:

<table>
<thead>
<tr>
<th>Segment</th>
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<td>96</td>
</tr>
</tbody>
</table>

What are the physical addresses for the following logical addresses?

- a. 1, 100
  - illegal reference (2300+100 is not within segment limits)
- b. 2, 0
  - physical address = 90 + 0 = 90
- c. 3, 580
  - illegal reference (1327 + 580 is not within segment limits)
Segmentation with Paging

- Modern architectures use segmentation with paging (or paged-segmentation) for memory

MULTICS Address Translation Scheme

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- “Modern Operating Systems” book and supplementary material by A. Tanenbaum
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