Lecture 21

Using & Managing Data:
Spreadsheets
(S&G, §§11.1–11.2)

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Some Important Applications of
Computers

• Spreadsheets
• Databases
• Symbolic & numeric computation
• Networks
• Artificial Intelligence

Relation to Algorithms

• Algorithmic problem solving is *used in*
these applications
• Algorithmic problem solving *uses* these
applications

Spreadsheet

• Visual system for representing and
manipulating tabular data
• Often used for:
  – budgets & other financial data
  – grades
• Useful for keeping dependant data
consistent
• Examples: Visicalc, Excel, Lotus 1-2-3

Example Spreadsheet

• Each cell has a “name”
  – e.g., “D2” is the cell in column D and row 2
• Cells can contain character data
  – e.g., names, column headings
• Cells can contain numeric data in various
formats
  – e.g., integer, real, currency, date, time
• Cells can contain formulas
  – e.g., “D2*E2”

Cells

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Relative & Fixed Cell References

- A name of the form “D2” is a relative reference to the cell in column D and row 2.
- A name of the form “$D$2” is a fixed reference to the cell in column D and row 2.
- When a formula is copied into another cell:
  - the fixed references refer to the same cells as they originally did
  - the relative references refer to cells in the same relative positions

Example

- Suppose in G2 we have the formula: D2 * (1 + $C$8 / 100) * E2
- When we copy it to G3 it will be: D3 * (1 + $C$8 / 100) * E3
- When we copy it to G4 it will be: D4 * (1 + $C$8 / 100) * E4
- And so forth

Run Excel Spreadsheet Example

Beginning Spreadsheet

Formula Entered in F2

Result of Formula in F2
Formula Copied into Rest of Column

Result of Formulas in Column F

Example Pie Chart of Column F

Scatter Chart of Columns D vs. C

Compute Sum of Column F

Resulting Sum
Formula for Projected Base Pay Increase

Resulting New Pay

Formula Relativized to Row 3

Formula Relativized to Row 4

Change Format of Column G

Resulting Reformatted Column G
Insert Column for Merit Raises

New Formula to Include Merit Raises

Resulting Projected New Total

Bar Chart of Old and New Pay

Goal Seeking: Adjust Base Rate so Total = $12,000

Calculated Base Rate to Meet Goal
Update Strategies

- Reevaluate every cell
- Reevaluate only those cells containing formulas
  - works on small spreadsheets
- Reevaluate only those cells that depend on the changed cell
  - problem: indirect dependencies (ripple effect)

Indirect Dependency

<table>
<thead>
<tr>
<th>Name</th>
<th>Age</th>
<th>PayRate</th>
<th>Heart Pay</th>
</tr>
</thead>
<tbody>
<tr>
<td>Janet Kay</td>
<td>51</td>
<td>150</td>
<td>13000</td>
</tr>
<tr>
<td>John</td>
<td>35</td>
<td>85</td>
<td>29450</td>
</tr>
<tr>
<td>Batu</td>
<td>17</td>
<td>67.70</td>
<td>10936.50</td>
</tr>
</tbody>
</table>

Result

<table>
<thead>
<tr>
<th>Name</th>
<th>Age</th>
<th>PayRate</th>
<th>Heart Pay</th>
</tr>
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<td>29450</td>
</tr>
<tr>
<td>Batu</td>
<td>17</td>
<td>67.70</td>
<td>10945.90</td>
</tr>
</tbody>
</table>

Problem of Indirect Dependencies

- Suppose change D2
  - Could look for all cells with a formula involving D2, and reevaluate those
  - But suppose F9 depends on F2, and F2 depends on D2
- Bad solution:
  1. check all cells & update those directly dependant on D2
  2. keep a list of them
  3. check all cells & update those directly dependent on those in list
  4. keep a list of these, and return to (3)
  5. continue until there are no changes

Better Solution

- Keep with each cell a list of all other cells directly dependant on it
- Update this list whenever a formula is changed
- Whenever a cell’s value is changed:
  - reevaluate all the cells that depend directly on it
  - reevaluate all the cells that depend directly on those cells
  - and so forth
Event-Driven Programming

- Each cell contains either:
  - data
  - or a formula, which is a little program
  - these formulas are *interpreted* directly (not compiled into machine code)

- Whenever a cell is modified:
  - it creates an event
  - which may trigger other events
  - must end (no circular dependencies)

- There is no iteration except that provided through the built-in functions & tools