

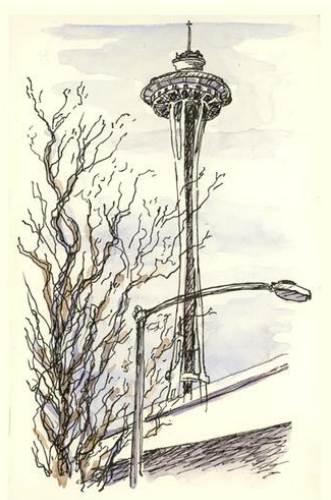
Tutorial on Graph-cuts and Its Usage in Graphics

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May 27, 2009

Understanding graph-cuts first

- Learning through example

Example – Graph-cuts for hiring



Seattle



John

You are hiring John and Amy for
two locations

Goal – minimize the cost



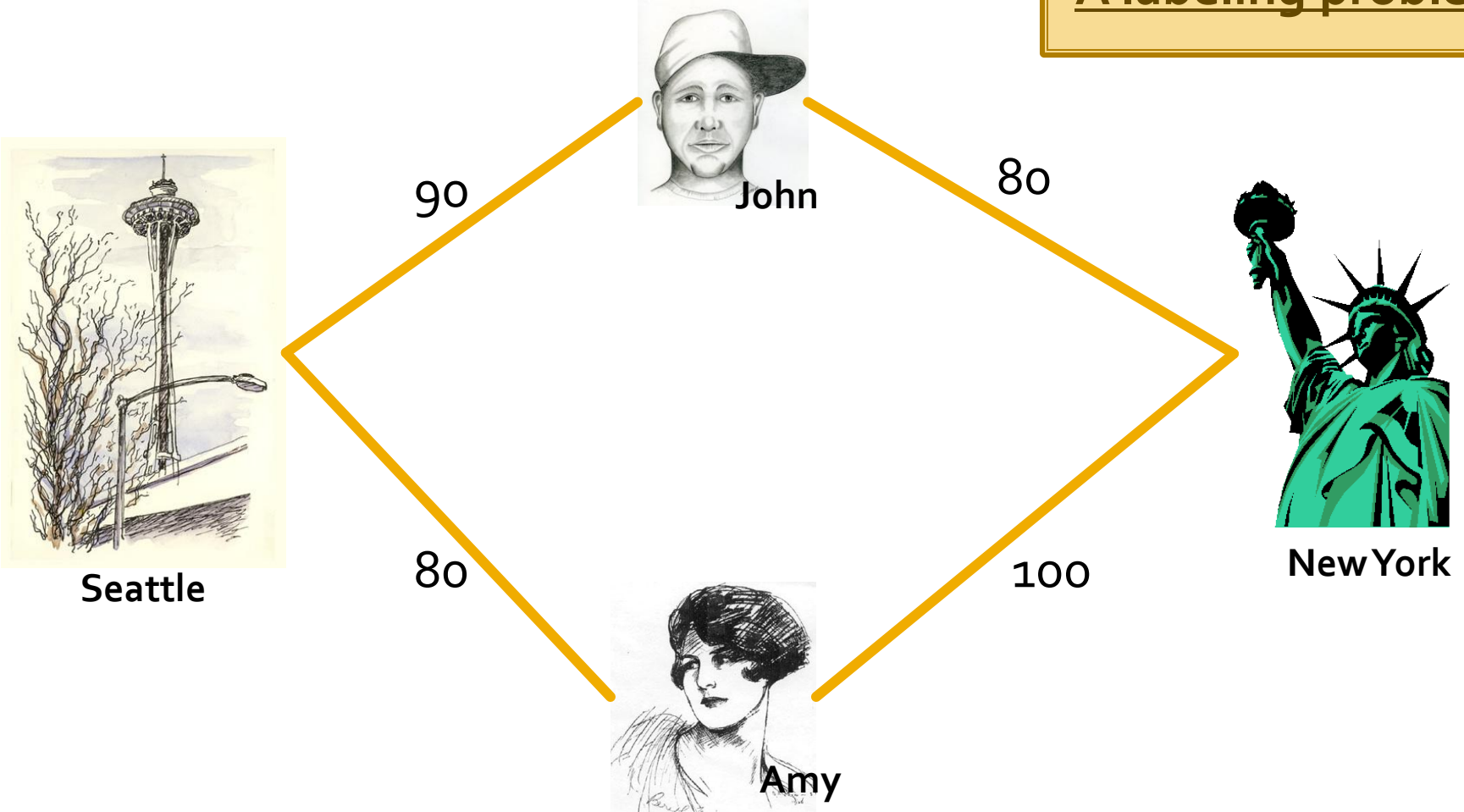
New York



Amy

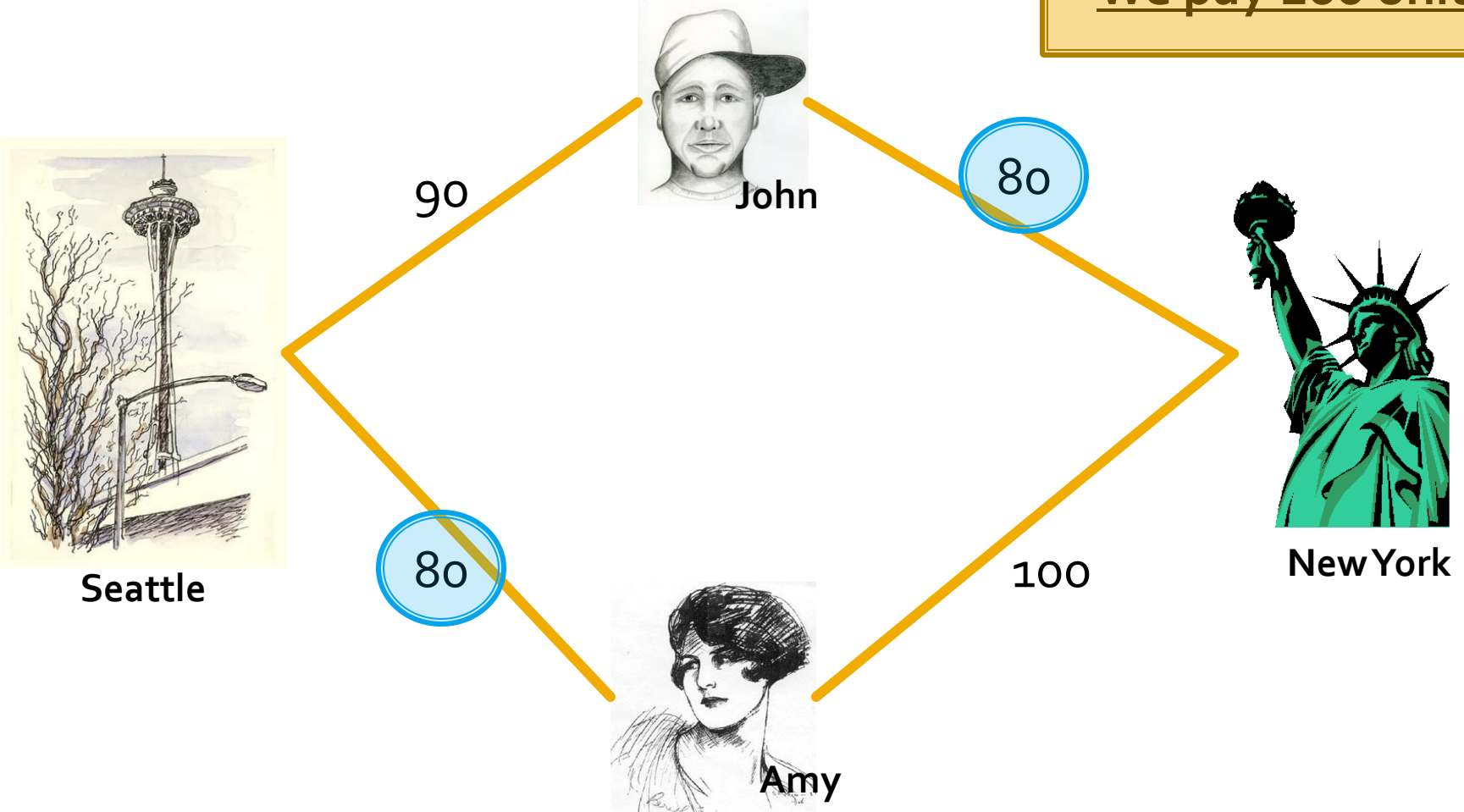
Example – Graph-cuts for hiring

A labeling problem



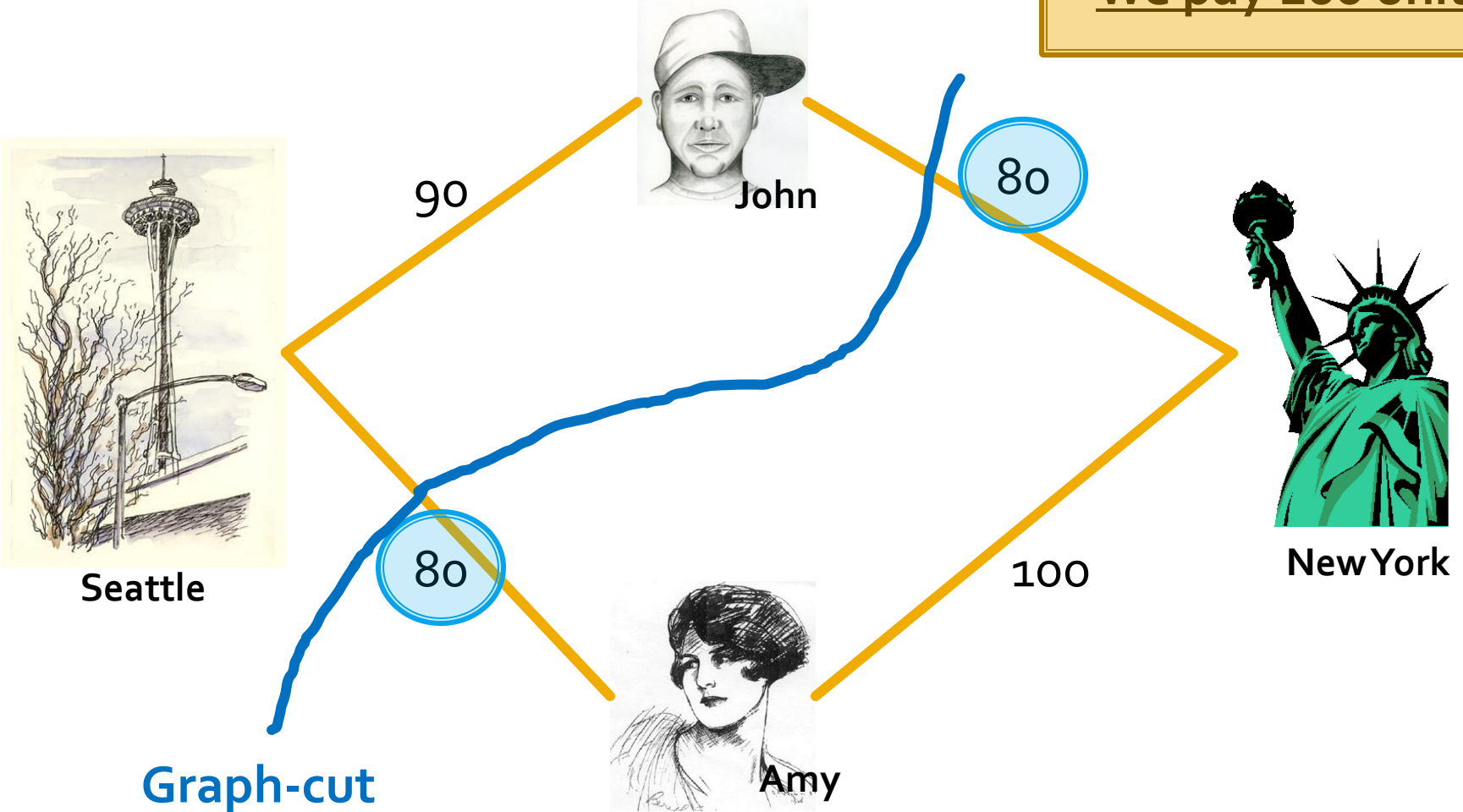
Example – Graph-cuts for hiring

We pay 160 units



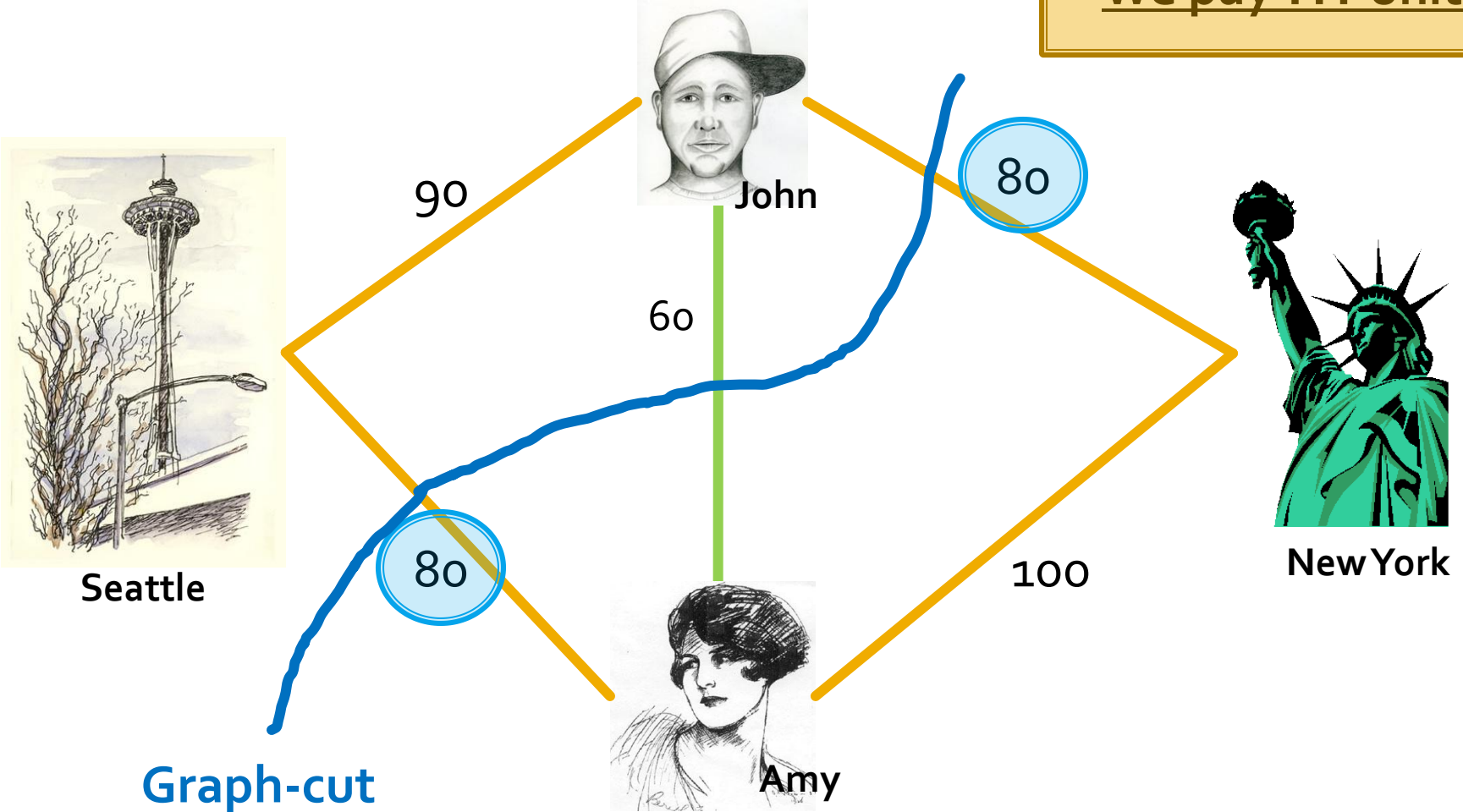
Example – Graph-cuts for hiring

We pay 160 units



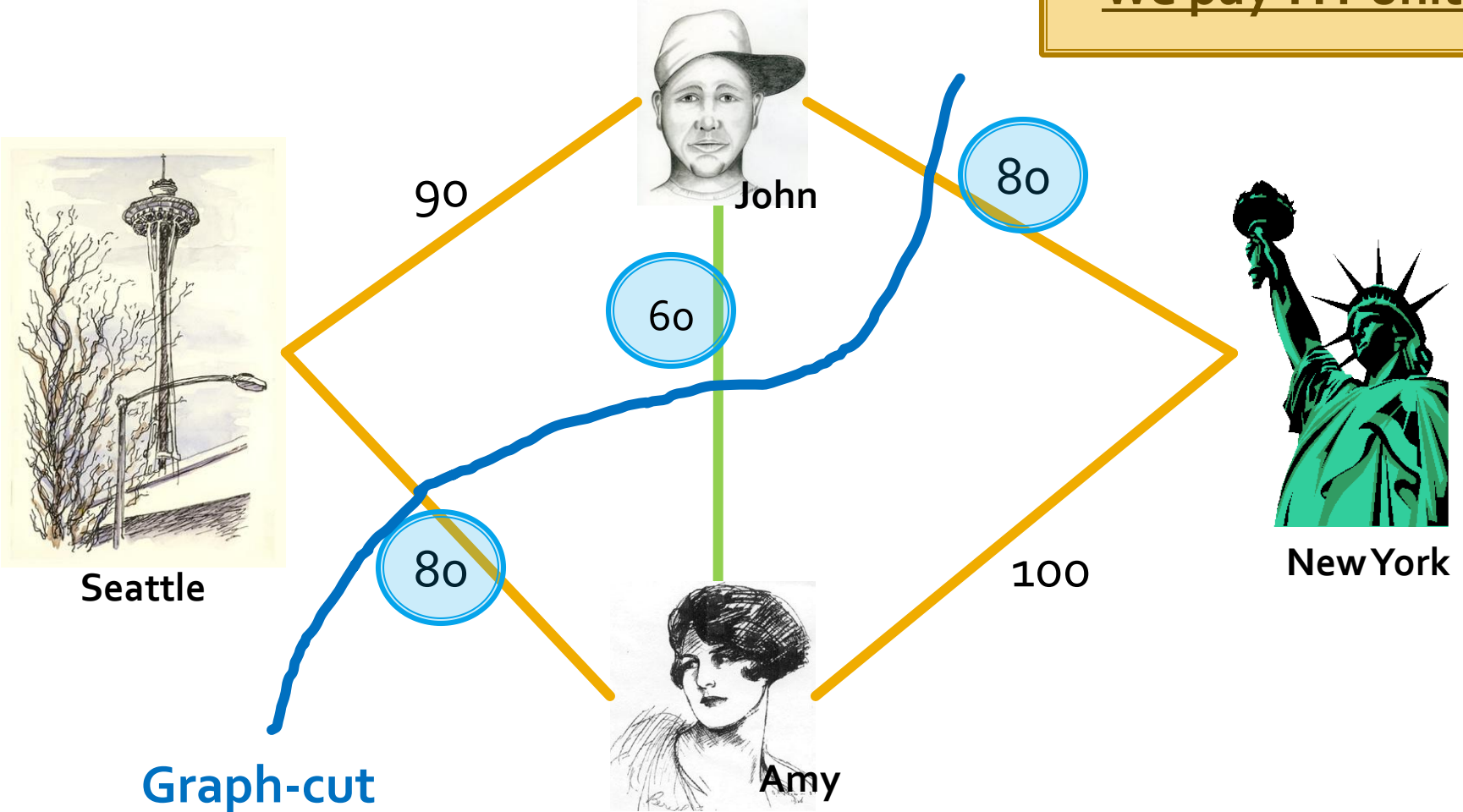
Example – Graph-cuts for hiring

We pay ??? units

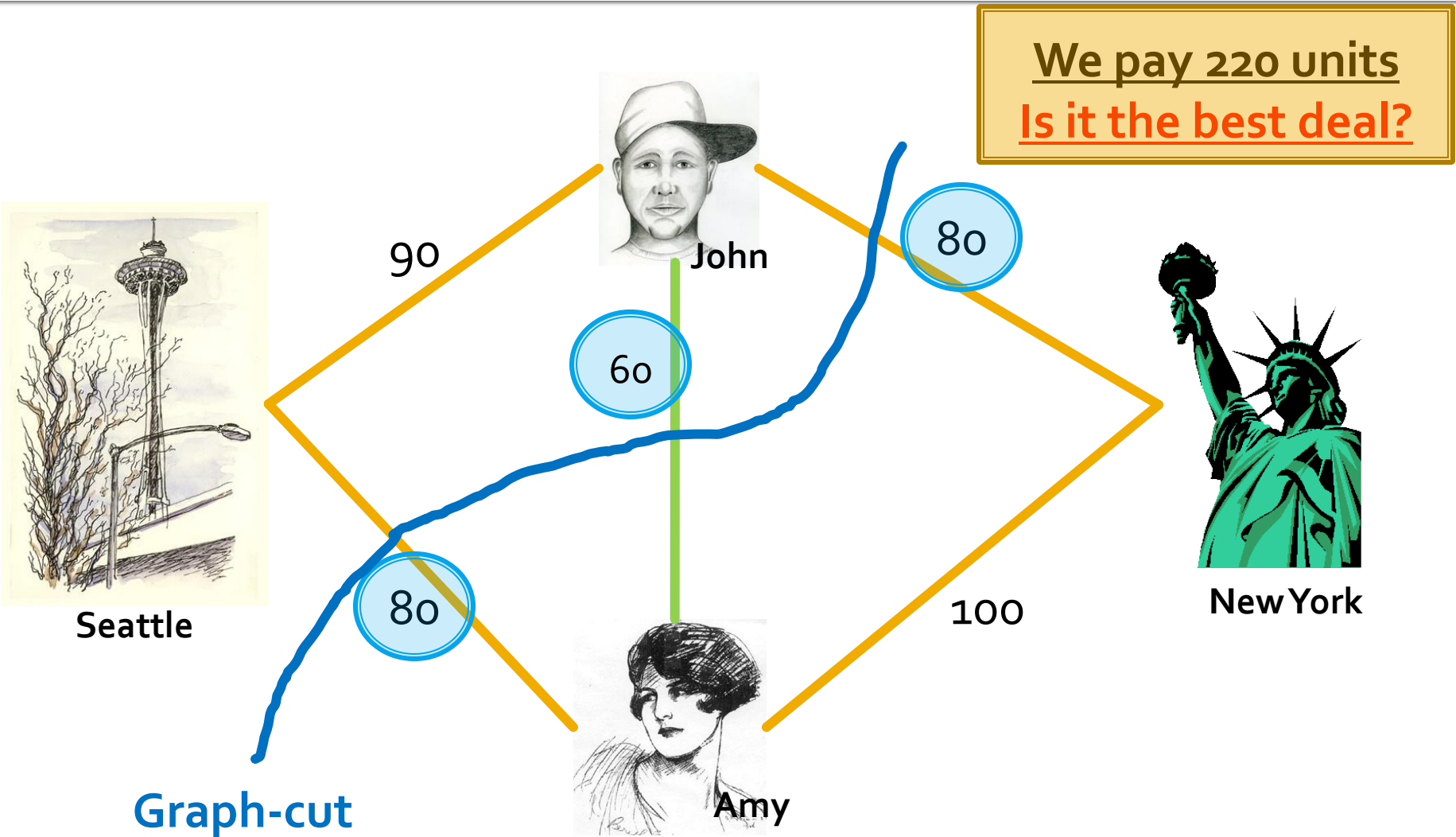


Example – Graph-cuts for hiring

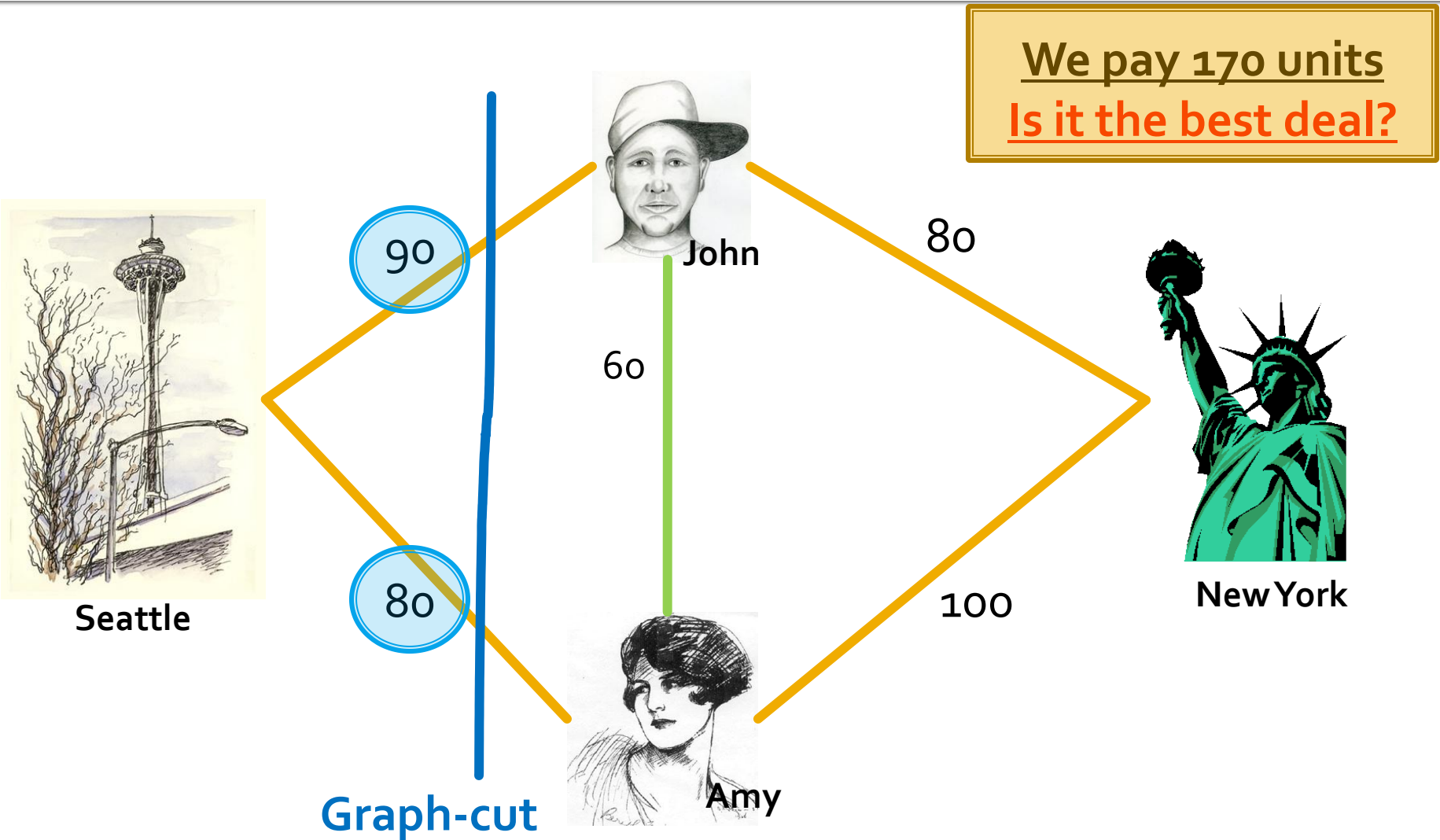
We pay ??? units



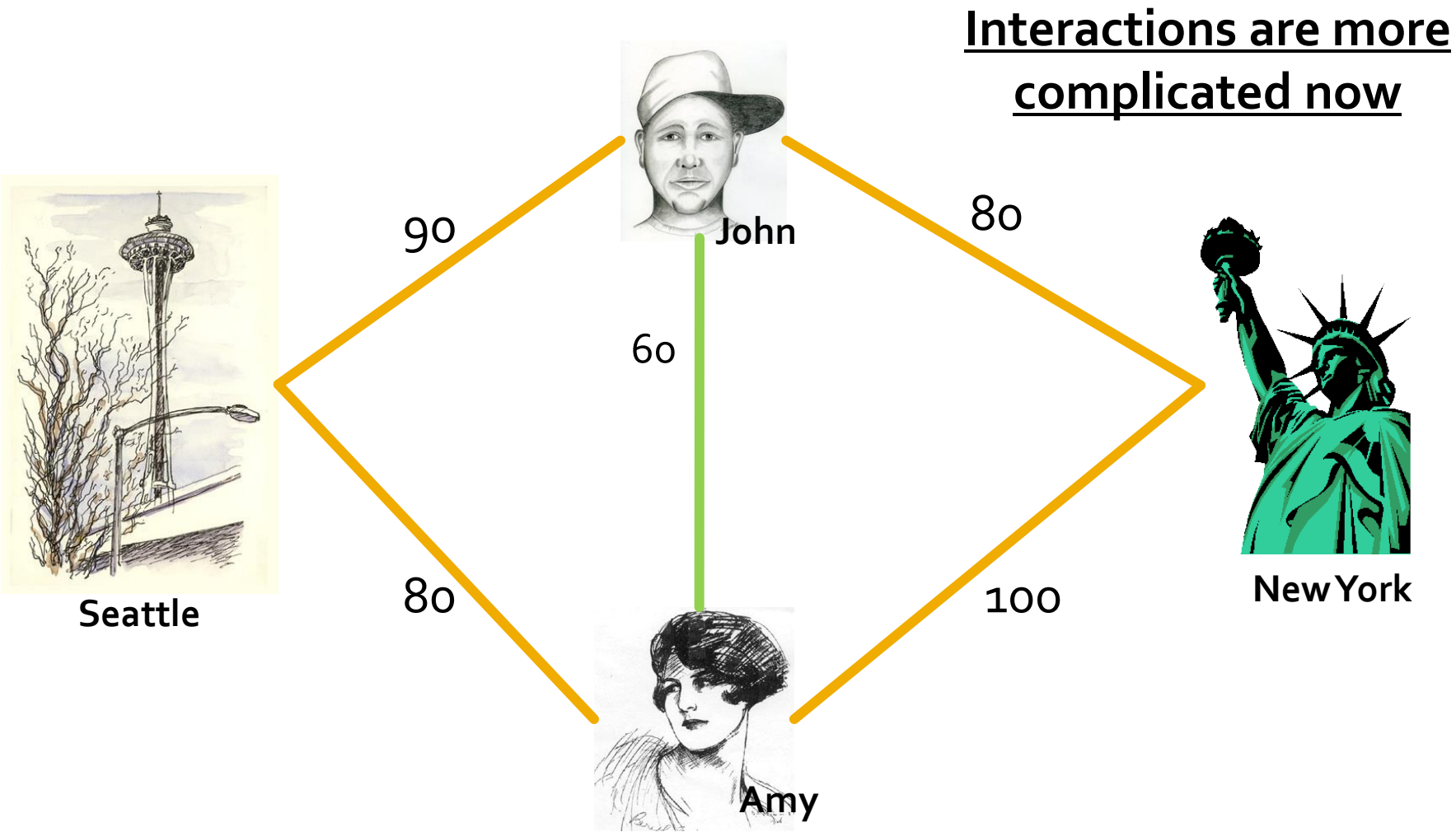
Example – Graph-cuts for hiring



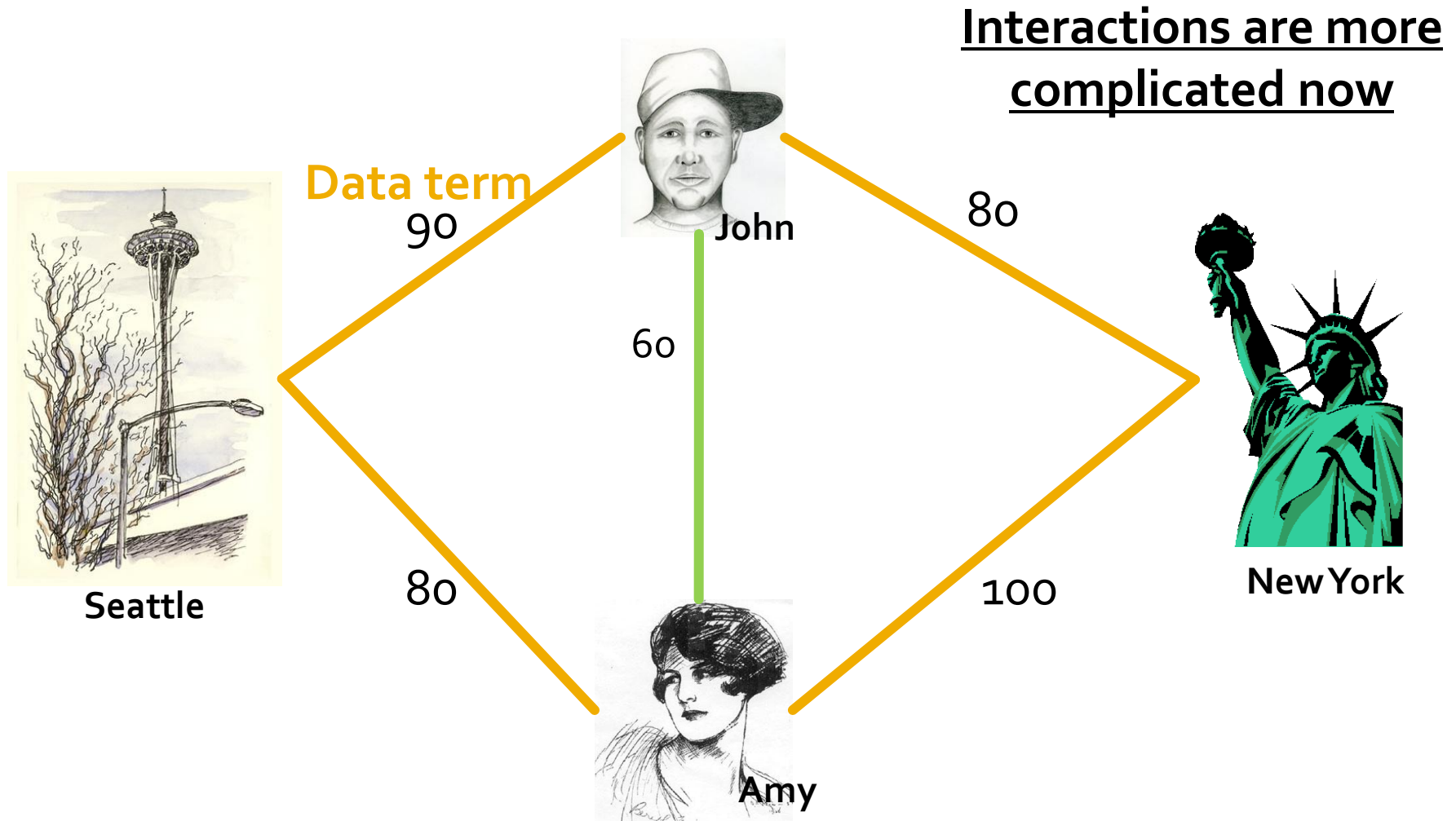
Example – Graph-cuts for hiring



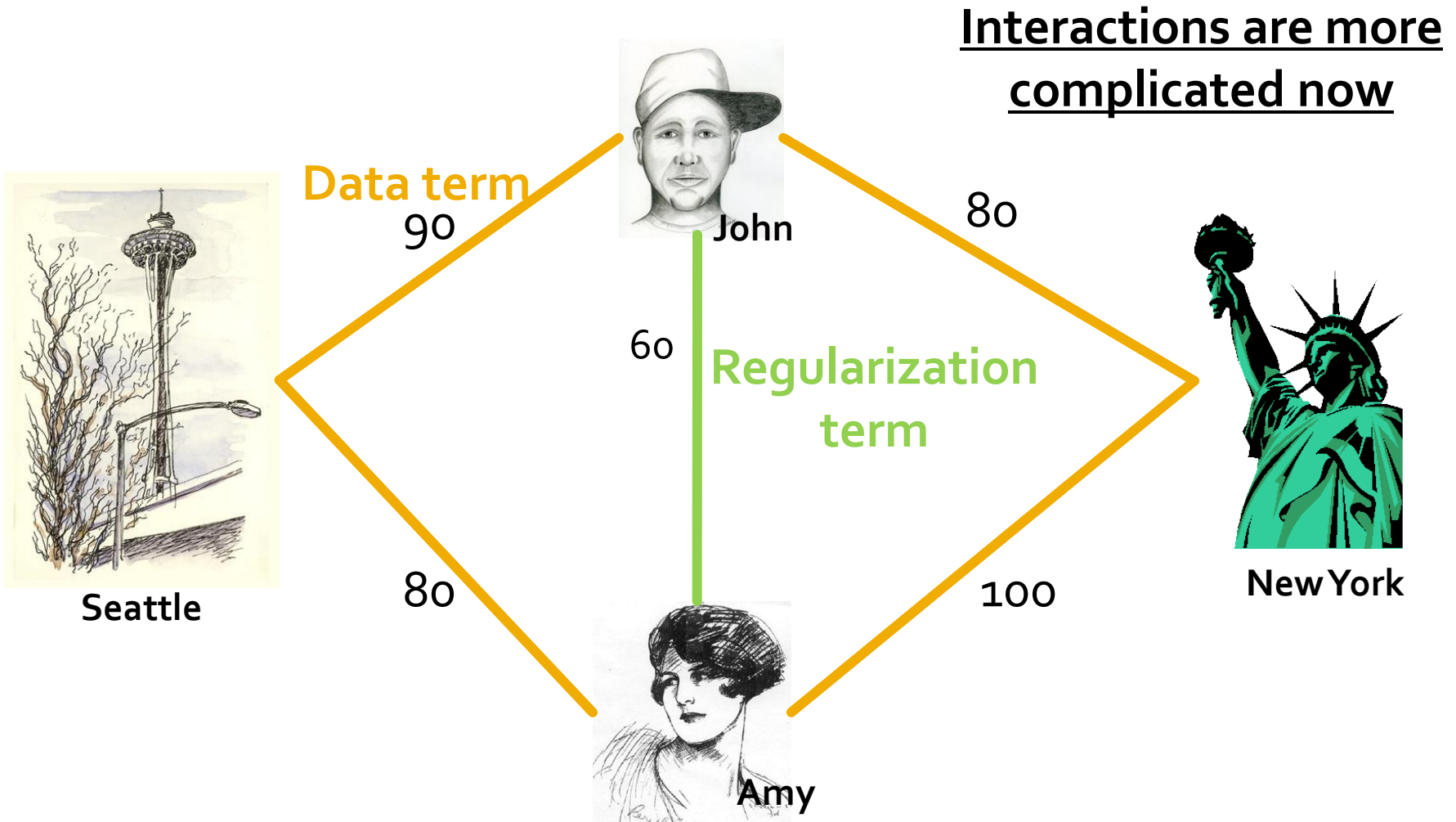
Example – Graph-cuts terminology



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Example – Graph-cuts terminology

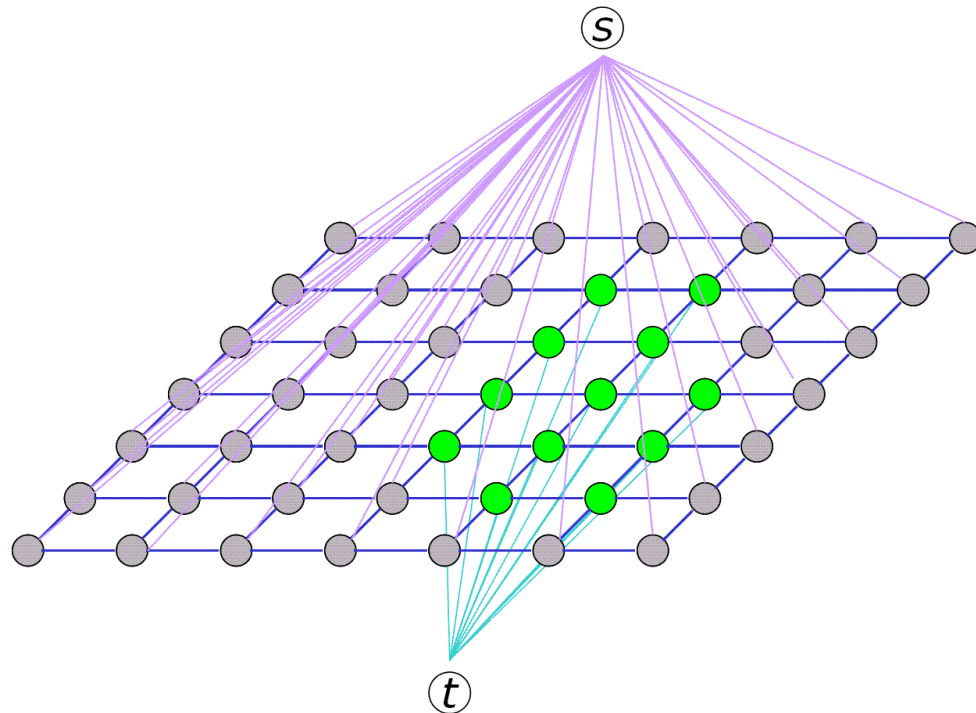


Graph-cuts optimization

- Labeling problem on graph nodes
- Total penalty has two terms
 - Data term – for assigning label to node
 - Regularization – for assigning labels to neighbors, tries to keep them together
- **Minimize**
(Data term) + (Regularization)

Solving Graph-cuts optimization

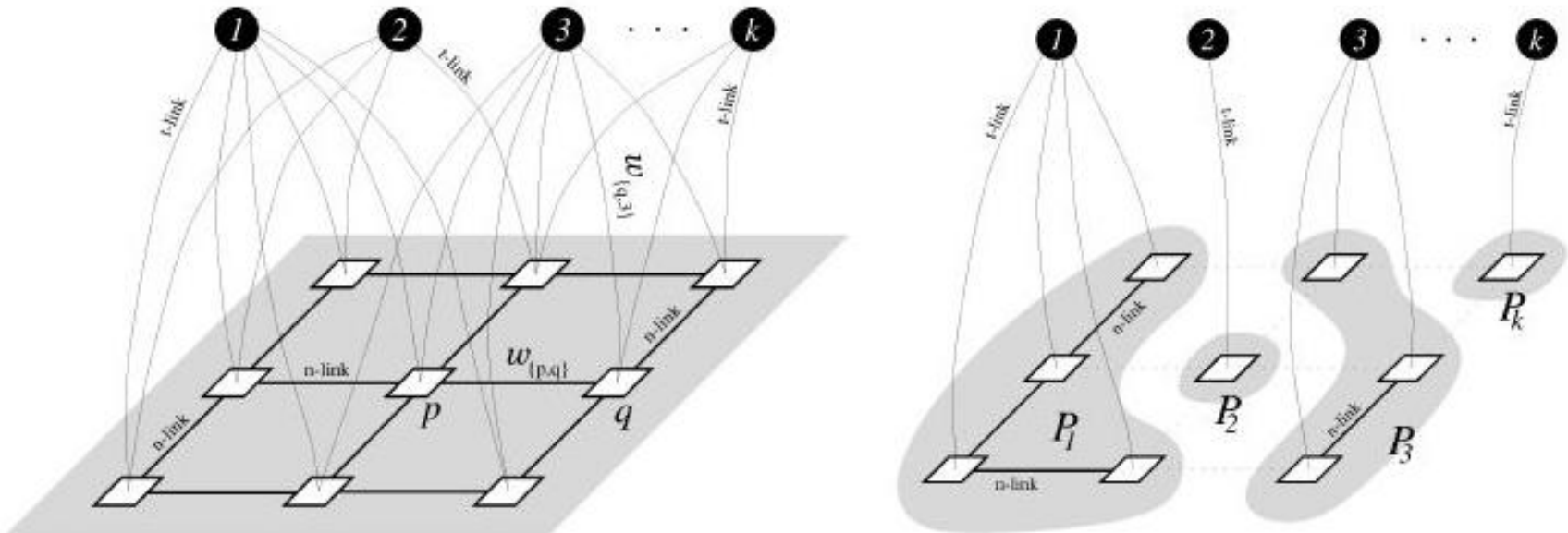
- For $\#(\text{labels}) = 2$



Exact solution by max-flow-min-cut algorithm

Solving Graph-cuts optimization

- For $\#(\text{labels}) > 2$



Approximate solution by alpha-expansion, belief propagation etc.

Solving Graph-cuts optimization

- Good news: Standard solvers are available !
- You can get graph-cuts optimization code from Vladimir Kolmogorov's website

<http://www.cs.ucl.ac.uk/staff/V.Kolmogorov/software.html>

Applications of graph-cuts to images

- GrabCut (Interactive Foreground Extraction)

Rother et al., SIGGRAPH 2004

[Microsoft Research]

- Digital Photomontage

Agarwala et al., SIGGRAPH 2004

[University of Washington, Microsoft Research]

Take home points

- Problem of assigning labels to nodes in graph
- Each node has some cost for a label
- Neighboring nodes have costs based on their labelings
- Under some conditions over cost values,

Standard graph cut algorithms can be used to minimize the total cost of labeling

