

# Discrete Optimization

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## 1 PERT-CPM

Lecture-10 preparation.

The following example of assembling a bicycle is taken from a Paper by Ron Graham.

Assembling a bicycle takes the following steps:

1. **FP** Frame preparation, including front fork and fenders.
2. **FW** Mounting and aligning the front wheel.
3. **BW** Mounting and aligning the back wheel.
4. **DE** Attaching the derailleur to the frame.
5. **GC** Installing the gear cluster.
6. **CW** Attaching the chain wheel to the crank.
7. **CR** Attaching the crank and chain wheel to the frame.
8. **RP** Mounting the right pedal and toe clip.
9. **LP** Mounting the left pedal and toe clip.
10. **FA** Final attachments.

The following table represents the time required for each step:

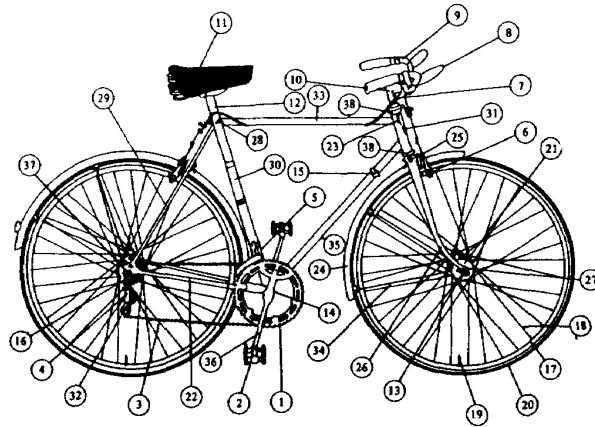
step	<b>FP</b>	<b>FW</b>	<b>BW</b>	<b>DE</b>	<b>GC</b>	<b>CW</b>	<b>CR</b>	<b>RP</b>	<b>LP</b>	<b>FA</b>
time	7	7	7	2	3	2	2	8	8	18

The following chart shows which jobs must precede the current job:

Job	Must be preceded by	These jobs
<b>FA</b>		<b>FP, FW, BW, GC, DE</b>
<b>BW</b>		<b>GC, DE</b>
<b>GC, CW</b>		<b>DE</b>
<b>LP, RP</b>		<b>CR, CW, GC</b>
<b>CR</b>		<b>CW</b>

. Draw the weighted Digraph and find the longest path in it.

## The Acme Bicycle



### Key to Bicycle Parts:

- |  |                                     |
|--|-------------------------------------|
| 1. Chainwheel  | 20. Tire                            |
| 2. Pedal   | 21. Hub (high-flange type)          |
| 3. Chain   | 22. Chainstay                       |
| 4. Rear derailleur                                   | 23. Lug                             |
| 5. Front derailleur                                  | 24. Fender                          |
| 6. Caliper brake                                     | 25. Fork crown                      |
| 7. Brake lever                                       | 26. Fork                            |
| 8. Brake cable                                       | 27. Wheel dropout                   |
| 9. Handlebars  | 28. Seat cluster lug                |
| 10. Handlebar stem                                   | 29. Seat stay                       |
| 11. Seat (saddle)                                    | 30. Seat tube                       |
| 12. Seat post  | 31. Steering head                   |
| 13. Quick-release skewer (for instant wheel removal) | 32. Tension roller, rear derailleur |
| 14. Bottom bracket                                   | 33. Top tube                        |
| 15. Gear-shift lever for rear derailleur             | 34. Fender brace                    |
| 16. Freewheel gear cluster                           | 35. Down tube                       |
| 17. Rim  | 36. Cotterless crank                |
| 18. Spoke  | 37. Rear drop out                   |
| 19. Valve  | 38. Headset (top and bottom)        |