

- CPLEX
 - ZIMPL
- $Ax \geq 1$ means $Ax \geq 1$ ($\hat{=} (1, \dots, 1)^T$)
- $x \geq 0$ means $x_i \geq 0 \forall i \in I$

CPLEX: commercial LP Solver (others Gurobi, Xpress, SCIP)

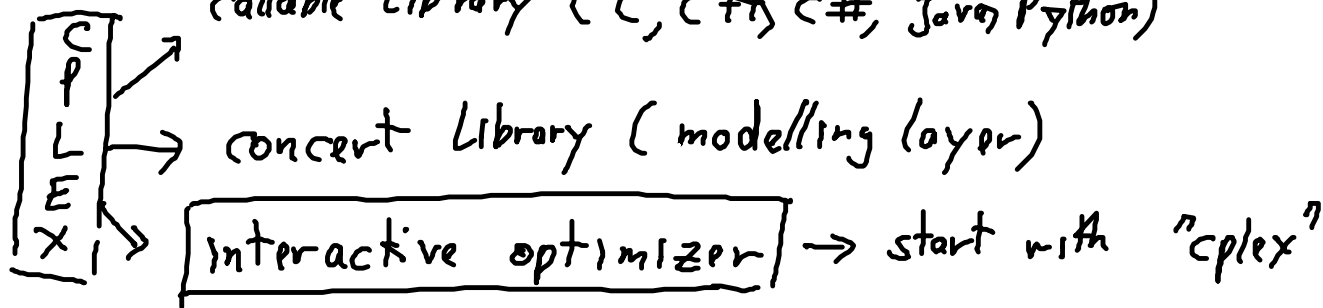
- History: founded by Robert Bixby 1987
 - sold to ILOG, Inc in 1997
 - ILOG was bought by IBM in 2009
- (Bixby started the development of Gurobi in 2008)

LP solving progress (1988 - 2004)

machines: 1600x faster
 algorithms: 3000x faster

=> total speed up ~ 5.3 million (2 months vs. 1 second)

callable library (C, C++, C#, Java, Python)



Input: LPs in .LP Format (-> link on our web page)

short introduction:

- 3 sections: objective, constraints, bounds
- comments start with "`!`"
- naming rules for variables, constr. and objective
 - ≤ 255 char. for a single name

- no '.' or number at the first position
 - no 'e'/'E' at the first position
 - optional names for constraints: <name>: _ _ _
 - objective starts with 'minimize' or 'maximize'
 - if empty, only feasibility problem
 - constraints: starting with single 'st'/'subject to'
 - $\underbrace{<=, <, =, < , >, >=, =}_{\text{all mean } <=}$, $\underbrace{>, >=, =}_{\text{all mean } >=}$
 - bounds: starts with 'bounds' (optional)
 - default: $0 \leq x \leq +\infty$
 - file ends with "end"
 - case insensitive ('f' = 'F'), right hand side of constr. has to be a coefficient
- example: (Air lift LP → ex. sess. 1)

Example problem	comment
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Minimize
obj: 200 p1 + 200 p2 + 200 p3 + 200 p4 + 7 mi1 + 7 mi2 + 7 mi3 + 7 mi4 + 10 m1
+ 10 m2 + 10 m3 + 10 m4 + 5 mr1 + 5 mr2 + 5 mr3 + 5 mr4

Subject To
c1: c1 = 100
c2: c2 = 150
c3: c3 = 150
c4: c4 = 200
c5: c1 + pi1 = 110
c6: - p1 - 0.8 c1 + c2 - pi1 + pi2 = 0
c7: - p2 - 0.8 c2 + c3 - pi2 + pi3 = 0
c8: - p3 - 0.8 c3 + c4 - pi3 + pi4 = 0
c9: mi1 + 0.05 m1 + 3 c1 = 330
c10: - mi1 + mi2 - m1 + 0.05 m2 + 3 c2 = 0
c11: - mi2 + mi3 - m2 + 0.05 m3 - mr2 + 3 c3 = 0
c12: - mi3 + mi4 - m3 + 0.05 m4 - mr3 + 3 c4 = 0
c13: mr1 = 0
c14: - mr2 + 2.4 c1 = 0
c15: - mr3 + 2.4 c2 = 0
c16: - mr4 + 2.4 c3 = 0

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Bounds
c1 >= 0

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End