

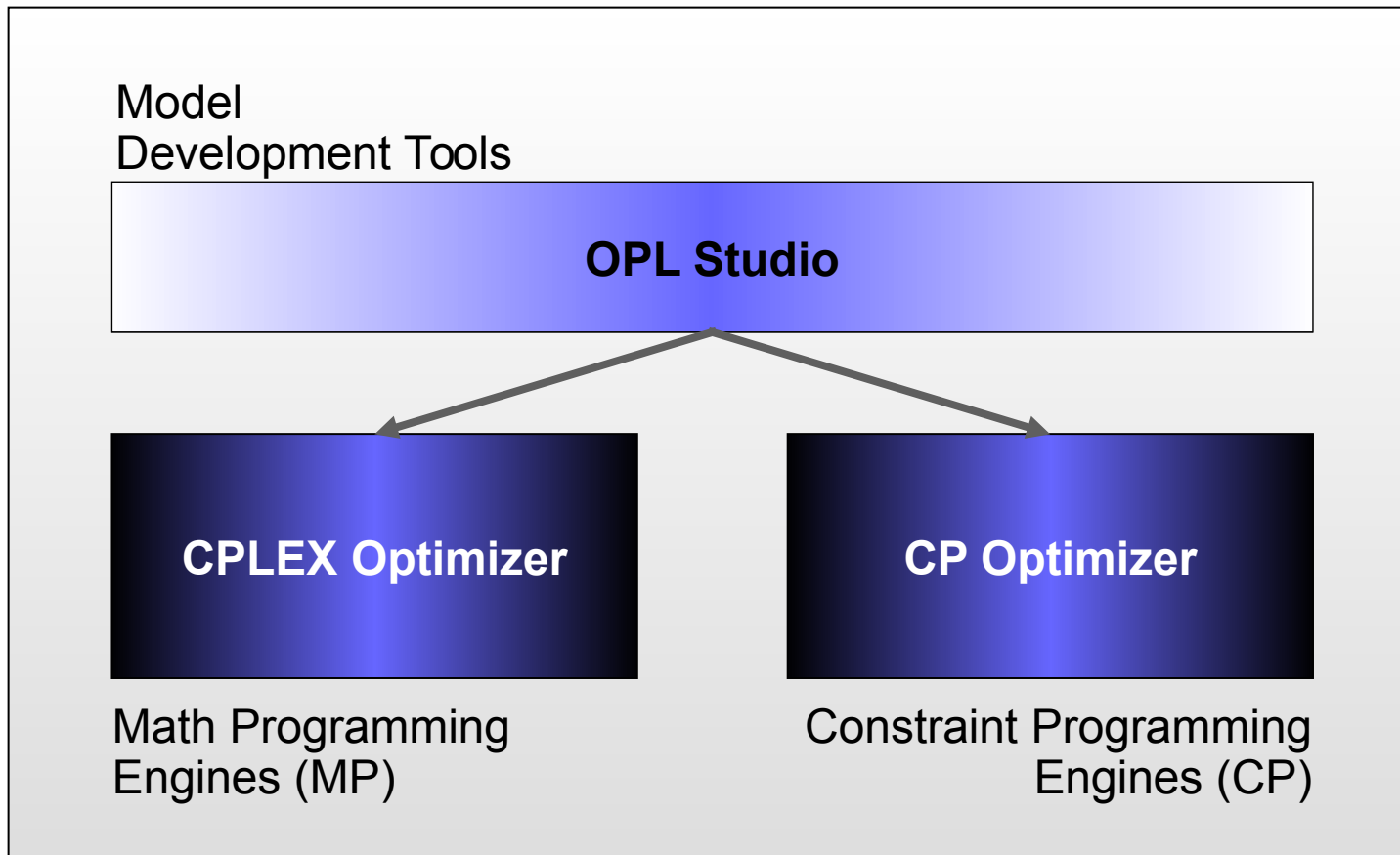
CP Optimizer Quick Introduction

CP Optimizer Development Team
Petr Vilím



What is CP Optimizer?

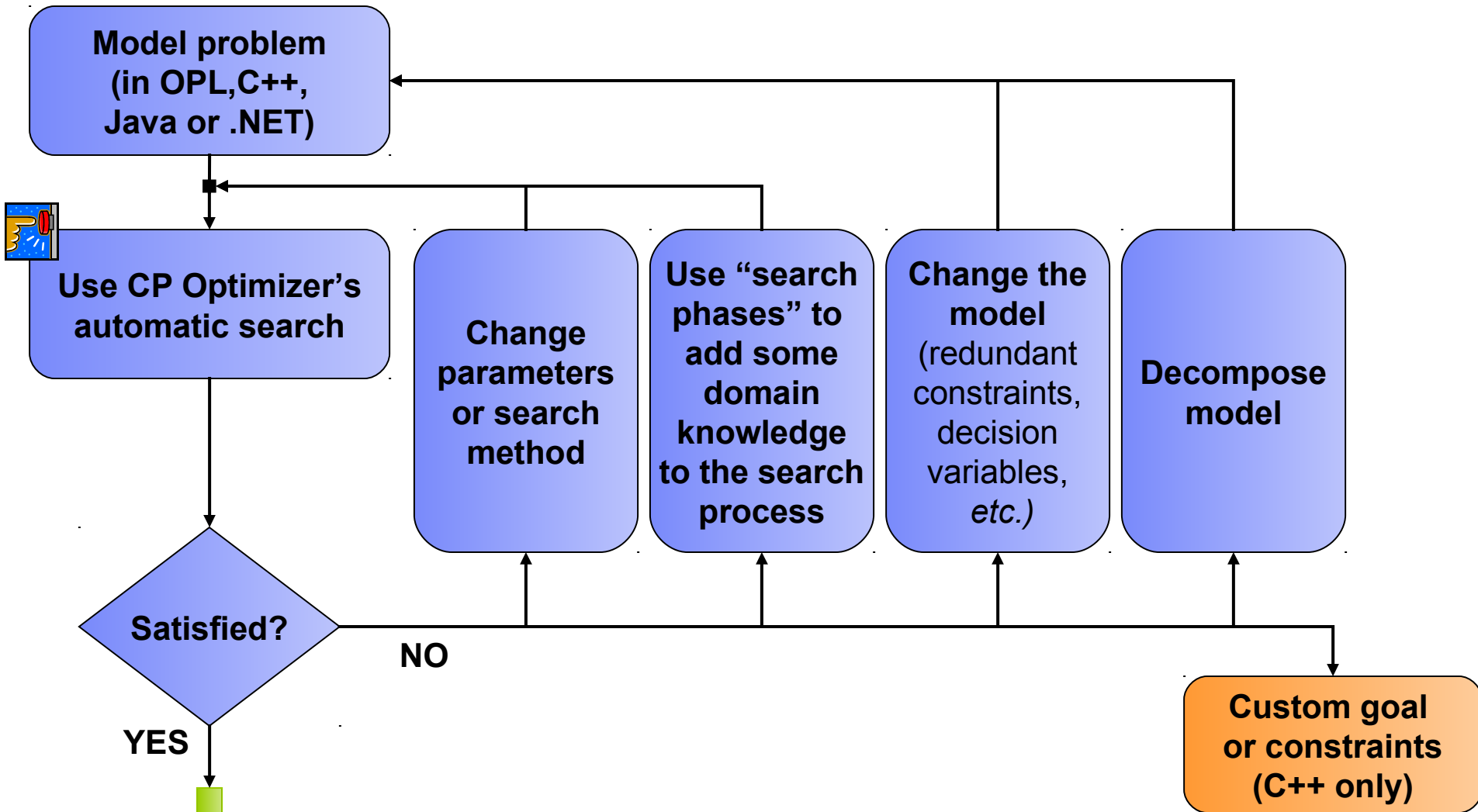
- A component of **IBM ILOG CPLEX Optimization Studio**



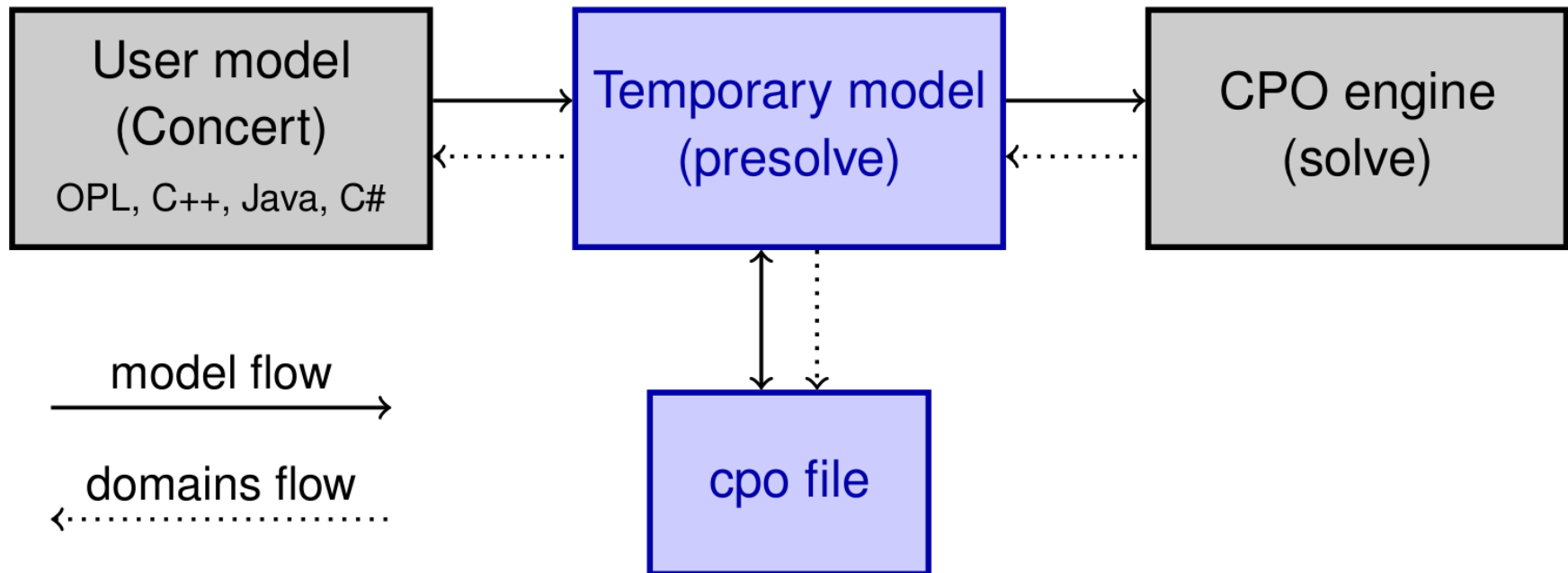
Getting CPLEX Optimization Studio

- Free of charge for academics via IBM Academic Initiative
- CP Optimizer is available through the following interfaces:
 - OPL
 - C++: native interface
 - Java: wrapping of the C++ engine
 - .NET: wrapping of the C++ engine
- and on the following platforms
 - 32-bit
 - Windows, Linux, Solaris, AIX, Darwin (Mac OS X)
 - 64-bit
 - Windows, Linux, Solaris, AIX

Typical use of CP Optimizer



Presolve



Examples of presolve

- Partial expression evaluation
- Common sub-expression elimination
- Precedence strengthening:
 - If a and b cannot overlap and $\text{startsBeforeStart}(a,b)$
 - then $\text{endsBeforeStart}(a,b)$.
- Precedence recognition:
 - If $\text{endOf}(a, \text{intmin}) \leq \text{startOf}(b, \text{intmax})$
 - then $\text{endsBeforeStart}(a,b)$.
 - Precedences are aggregated into **temporal network** for faster and stronger propagation.
- 2-SAT clauses recognition:
 - $\text{presenceOf}(a) \leq \text{presenceOf}(b)$
 - $\text{presenceOf}(a) = \text{presenceOf}(b)$
 - Such clauses are aggregated into **logical network** for stronger propagation.
- Cumulative expressions are preprocessed into cumulative constraints.

New feature: Optimization on cloud (demo)

<http://www-969.ibm.com/software/analytics/docloud/>

The screenshot displays the IBM Decision Optimization on Cloud interface. The top navigation bar includes the IBM logo, the user name 'Petr Vilím / Sign out', and the product name 'Decision Optimization on Cloud' with a 'BETA' badge. The main navigation menu contains 'DropSolve', 'FAQ & Samples', and 'Developer'. A left sidebar offers 'Free Trial' and 'Send us feedback' options. The central area features the 'DropSolve' logo and instructions: 'Drop your problem file(s) and download results when complete. All relevant files must be dropped in together (lp, mps, sav, prn, mod, dat, ops ...)' with a link to 'FAQ & Samples'. A large dashed box prompts the user to 'Drop a problem here to solve' or 'click to select file(s) from your computer'. At the bottom, a file upload status bar shows 'sched_jobshop.mod (2K) 1 more file' as 'Completed', with icons for 'Results', 'Info', 'Log', and a close button.

IBM

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Decision Optimization on Cloud **BETA**

DropSolve FAQ & Samples Developer ▾

Free Trial

Send us feedback

DropSolve

Drop your problem file(s) and download results when complete.
All relevant files must be dropped in together (lp, mps, sav, prn, mod, dat, ops ...)

More information in [FAQ & Samples](#)

Drop a problem here to solve
or click to select file(s) from your computer

✓ sched_jobshop.mod (2K) 1
more file
Completed

Results Info Log

New feature: CPO file format

```
internals {  
    version(12.6.1.0);  
    architecture("x86-64_linux/static_pic", 64);  
    ids(0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17);  
}  
  
// Interval-related variables:  
a = intervalVar(size=5, optional);  
b = intervalVar(start=1..intervalmax, size=5);  
c = intervalVar(start=2..intervalmax, end=0..14, size=7);  
x = intervalVar(start=-100..intervalmax, end=intervalmin..intervalmax, size=1);  
  
// Objective:  
minimize(endOf(a) + endOf(b) + endOf(c) + endOf(x));  
  
// Constraints:  
noOverlap([a, b, c, x]);  
startBeforeEnd(b, a, -6);  
#line foo.cpp 150  
startBeforeEnd(a, x, -10);  
  
parameters {  
    LogVerbosity = Quiet;  
}
```


New feature: Warnings

Like a compiler, CP Optimizer can print warnings

- When there is something suspicious in the model.
 - Especially for scheduling
- Regardless how the model was created (C++, OPL, ..)
- Including guilty part of the model in the cpo file format
- Including source code line numbers (if known)
- 3 levels of warnings, more than 50 types of warnings

```
foo.cpp:24: Warning: Unused interval variable x .
```

```
    x = intervalVar(start=1..50, size=5..10)
```

```
foo.cpp:30: Warning: Constraint alternative: master interval variable task  
                is optional but alternative interval model is present.
```

```
    alternative(task, [model1, mode2])
```

```
file.cpo:7: Warning: Constraint alternative: array of alternatives is empty.  
                Interval variable A will be set to absent.
```

```
    alternative(A, [])
```