# ΕΛΠ 605: Προχωρημένη Αρχιτεκτονική Υπολογιστών

## Φροντιστήριο Αρ. 8

**PARSEC 3.0**

Princeton Application Repository for Shared-Memory Computers (PARSEC)

http://parsec.cs.princeton.edu/index.htm

# PARSEC

The Princeton Application Repository for Shared-Memory Computers (PARSEC) is a benchmark suite composed of **multithreaded programs**. The suite focuses on emerging workloads and was designed to contain a diverse selection of applications that is representative of next-generation **shared-memory programs for chip-multiprocessors.**

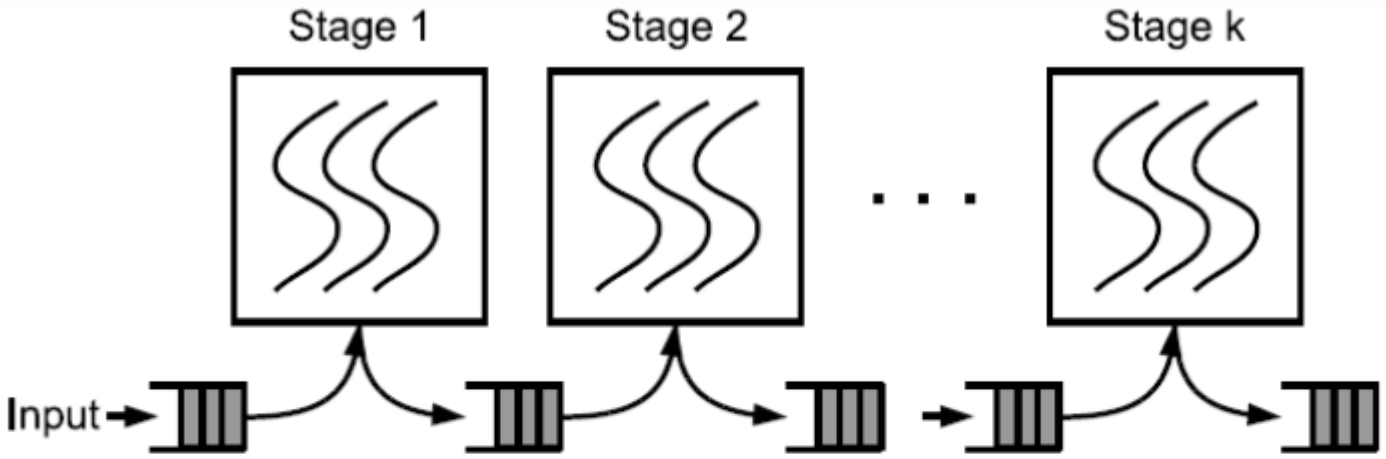
http://wiki.cs.princeton.edu/index.php/PARSEC

# Workloads

| Program | Application Domain | Parallelization | | Working Set | Data Usage | |
|---|---|---|---|---|---|---|
| | | Model | Granularity | | Sharing | Exchange |
| blackscholes | Financial Analysis | data-parallel | coarse | small | low | low |
| bodytrack | Computer Vision | data-parallel | medium | medium | high | medium |
| canneal | Engineering | unstructured | fine | unbounded | high | high |
| dedup | Enterprise Storage | pipeline | medium | unbounded | high | high |
| facesim | Animation | data-parallel | coarse | large | low | medium |
| ferret | Similarity Search | pipeline | medium | unbounded | high | high |
| fluidanimate | Animation | data-parallel | fine | large | low | medium |
| freqmine | Data Mining | data-parallel | medium | unbounded | high | medium |
| raytrace | Rendering | data-parallel | medium | unbounded | high | low |
| streamcluster | Data Mining | data-parallel | medium | medium | low | medium |
| swaptions | Financial Analysis | data-parallel | coarse | medium | low | low |
| vips | Media Processing | data-parallel | coarse | medium | low | medium |
| x264 | Media Processing | pipeline | coarse | medium | high | high |

http://parsec.cs.princeton.edu/download/tutorial/3.0/parsec-tutorial.pdf

# Pipelined Programming Model




- Pipelined programming model is the most common model used in products
  - Clean interfaces and modules
  - Parallel programming

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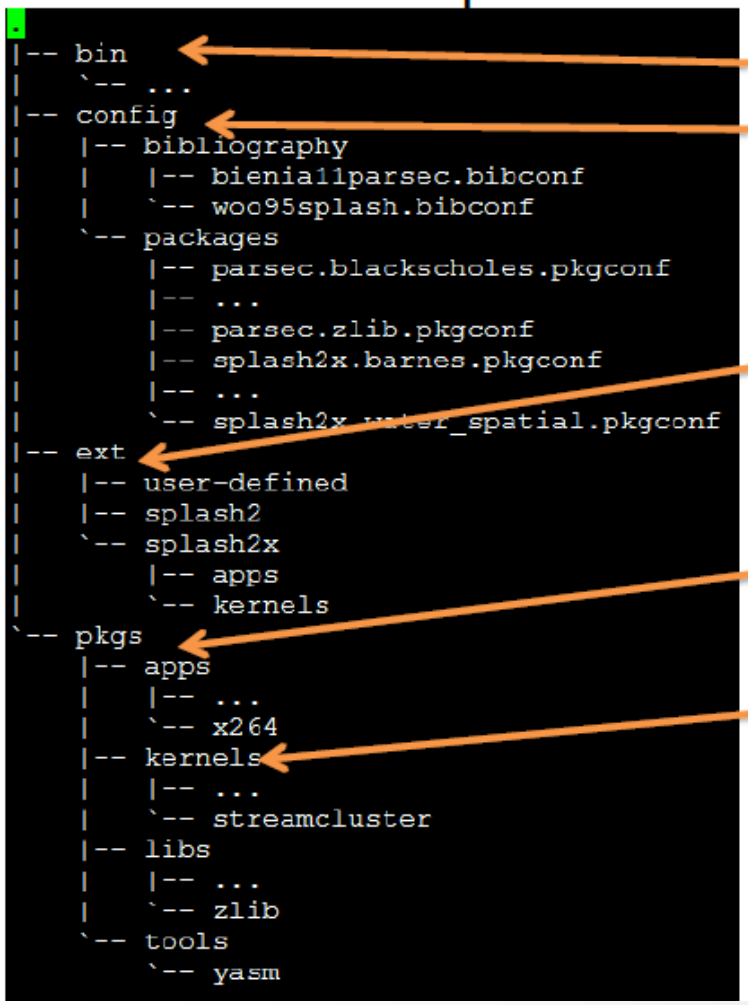
# Framework Directory Structure

- PARSEC is composed of the framework and packages




Framework executable files

Global configuration files

Extended benchmark directory

PARSEC benchmark directory

Each group directory contains one directory per package in that group

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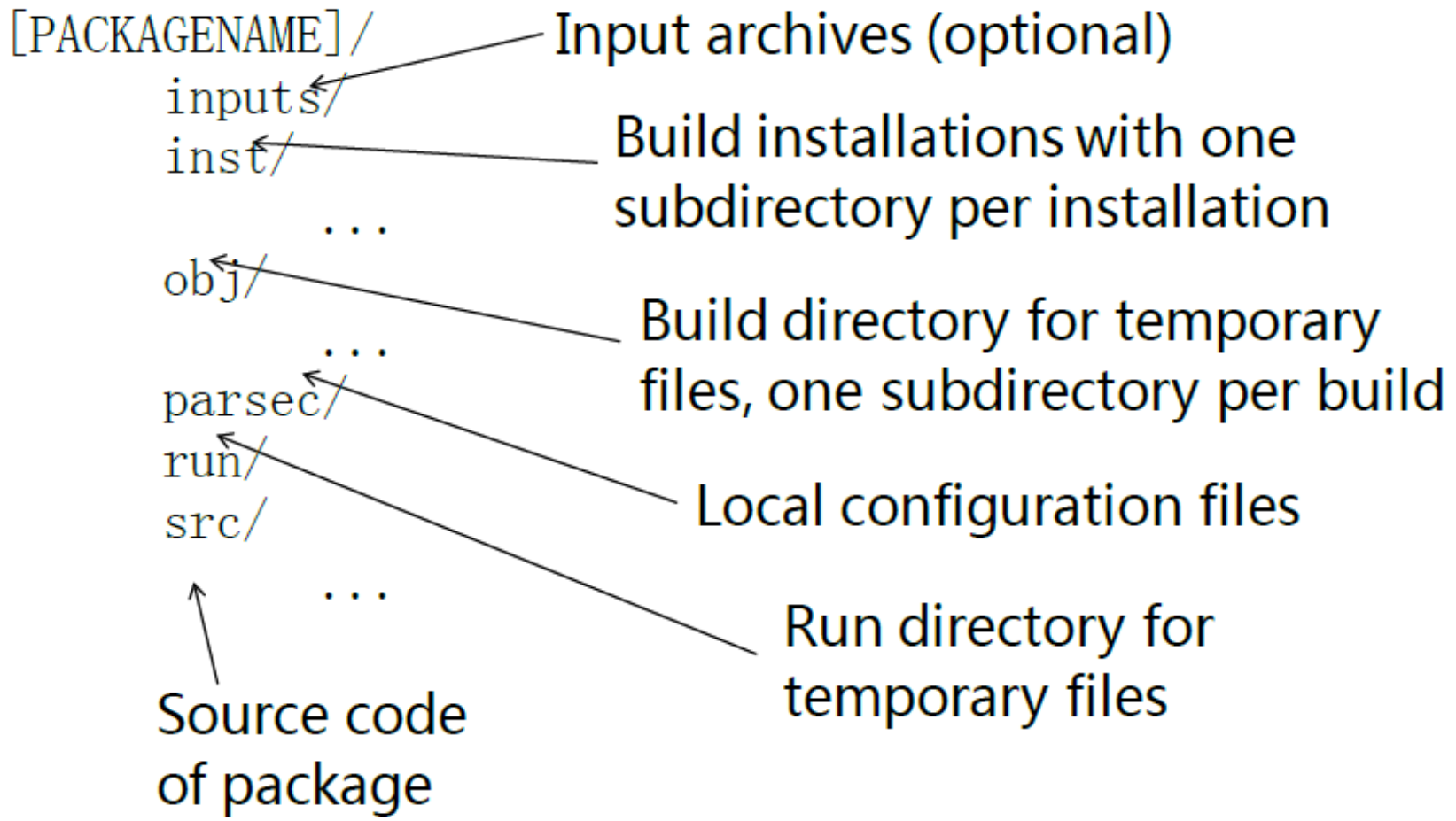
# Package Directory Structure

Each package directory is structured as follows:

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# Configuration Files

- Global configuration files (in `config/` directory of framework):
  - PARSEC main configuration file: `parsec.conf`
    - `3.0 → package`
  - System configurations: `[OSNAME].sysconf`
  - Global build configurations: `[BUILDCONF].bldconf`
  - Global run configurations: `[INPUT].runconf`
- Local configuration files (in `parsec/` directory of each package):
  - Local build configurations: `[BUILDCONF].bldconf`
  - Local run configurations: `[INPUT].runconf`

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# Building Workloads

- You can build a PARSEC workload as follows:

```
parsecmgmt -a build -p [suite].[PACKAGE]
```

- Flag '`-a`' specifies the desired action, flag '`-p`' gives one or more packages
- A package can be a workload, library or anything else that comes with PARSEC and can be compiled
- '`parsecmgmt -a info`' gives you a list of all available packages
- `Parsecmgmt` will automatically handle dependencies between packages correctly

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# Build Configurations

```
source env.sh
bin/parsecmgmt -a build -p canneal -c gcc-serial
```

Q: How do you build workload `canneal` with build configuration `gcc-serial`?

A: You can use the following command:

```
> parsecmgmt -a build -p canneal -c gcc-serial
[PARSEC] Packages to build:  canneal

[PARSEC] [========== Building package canneal ==========]
[PARSEC] [---------- Analyzing package canneal ----------]
[PARSEC] canneal depends on: hooks
[PARSEC] [---------- Analyzing package hooks ----------]
[PARSEC] hooks does not depend on any other packages.
[PARSEC] [---------- Building package hooks ----------]
[PARSEC] Copying source code of package hooks.
[PARSEC] Running 'env make':
/usr/bin/gcc -O3 -funroll-loops -fprefetch-loop-arrays
-DPARSEC_VERSION=2.0 -Wall -std=c99 -D_GNU_SOURCE
-D_XOPEN_SOURCE=600 -c hooks.c
ar rcs libhooks.a hooks.o
ranlib libhooks.a
[PARSEC] Running 'env make install':
```

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# Running Benchmarks

```
bin/parsecmgmt -a run -p canneal -c gcc-serial -i simsmall
```

```
[PARSEC] Benchmarks to run:  parsec.canneal
[PARSEC] [========== Running benchmark parsec.canneal [1] ==========]
[PARSEC] Setting up run directory.
[PARSEC] Unpacking benchmark input 'simsmall'.
100000.nets
[PARSEC] Running 'time /home/faculty/petrosp/EPL370/Benchmarks/parsec3.0/parsec-3.0/pkgs/kernels/canneal/inst/amd64-
    linux.gcc-serial/bin/canneal 1 10000 2000 100000.nets 32':
[PARSEC] [---------- Beginning of output ----------]
PARSEC Benchmark Suite Version 3.0-beta-20120904
Threadcount: 1
10000 swaps per temperature step
start temperature: 2000
netlist filename: 100000.nets
number of temperature steps: 32
...
Just saw element: 100000
netlist created. 100000 elements.
Final routing is: 9.27689e+07
real    0m2.130s
user    0m2.059s
sys     0m0.031s
[PARSEC] [----------    End of output    ----------]
[PARSEC] BIBLIOGRAPHY
[PARSEC] [1] Bienia. Benchmarking Modern Multiprocessors. Ph.D. Thesis, 2011.
[PARSEC] Done.
```

# Input Sets

- `Test`
  Execute program, as small as possible, best-effort execution path as real inputs
- `Simdev`
  Stresses all machine parts required by larger input sets, same execution path as real inputs
- `Simsmall`
  Like real inputs, runtime ~1s
- `Simmedium`
  Like real inputs, runtime ~5s
- `Simlarge`
  Like real inputs, runtime ~15s
- `Native`
  Like real inputs, runtime ~15min

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# Modify the gcc Options

This is bug and we will fix it in an update version soon. Please comment the following lines start from line 181 in "bin/bldconfadd"

```
# Source global configuration file with alias definitions, package dependencies etc.
# parsecconfig="${PARSECDIR}/config/parsec.conf"
# if [ -f "${parsecconfig}" ]; then
# source ${parsecconfig}
# else
 # echo "${oprefix} Error: Cannot load global configuration file '${parsecconfig}'."
# exit 1
# fi
```

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# Modify the gcc Options

```
bash; source env.sh
bldconfadd -n gcc-debug -c gcc
cd pkgs/kernels/canneal/parsec
vi gcc-debug.bldconf
#!/bin/bash

# gcc-debug.bldconf - configuration file for PARSEC
build_inplace="TRUE"
source ${PARSECDIR}/config/gcc.bldconf
CFLAGS="${CFLAGS} -O0 -g”
CXXFLAGS=”${CXXFLAGS} -O0 -g”

parsecmgmt -a build -p canneal -c gcc-debug
parsecmgmt -a run -p canneal -c gcc-debug -i simsmall
```

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