Dataflow programming languages: LabVIEW

Andrea Sterbini – sterbini@di.uniroma1.it

Data-flow: interconnected functional units

Functional units connected by data-links

- links represent data exchanges (i.e. variables)
- they could be typed
- many data can be aggregated in a single BUS (i.e. record)
- each unit has a default GUI for testing its I/O

Granularity

- functional units can be defined and reused
- circuits/networks can be packaged as new blocks

LabVIEW

Created by National Instruments to interact with digital data-acquisition and control systems

Modelled over the circuit design and testing metaphor

Each functional unit in the graphic language runs as soon all its input data are available

Multiple cores and threads are used to schedule the parallel execution of multiple active units

The programs are compiled into an intermediate “G” language
(but can also be compiled to native code)

You normally (need to) add explanation boxes to document your ideas

Concurrency

Inherently parallel

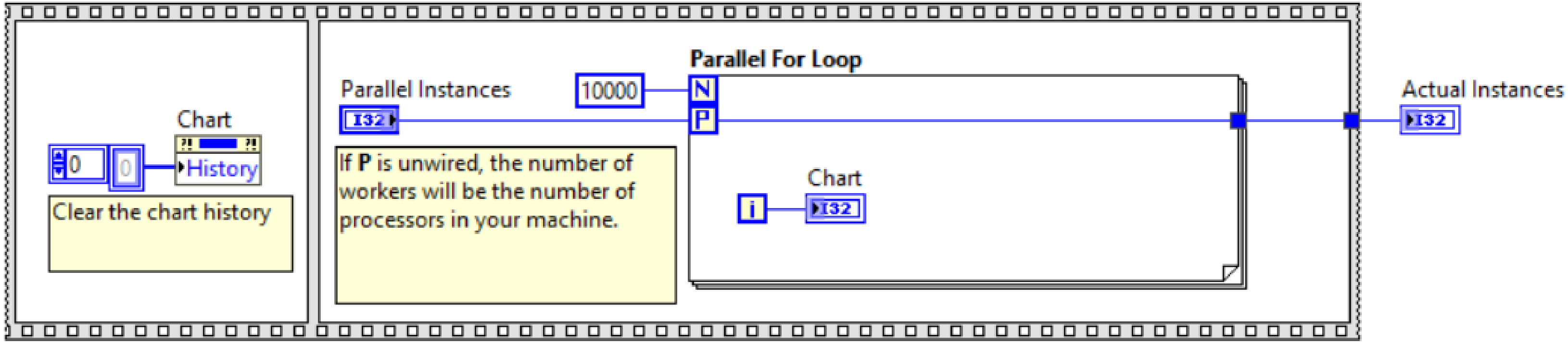
- linked units must run sequentially because of data dependency
- NON-linked units run in parallel

Synchronization

- a block starts when all input data is available

Sequencing constraints

- data dependencies (links induce time order)
- you can add time dependencies without data exchange
  (or you could add data dependencies to do the same)



Clear the chart history

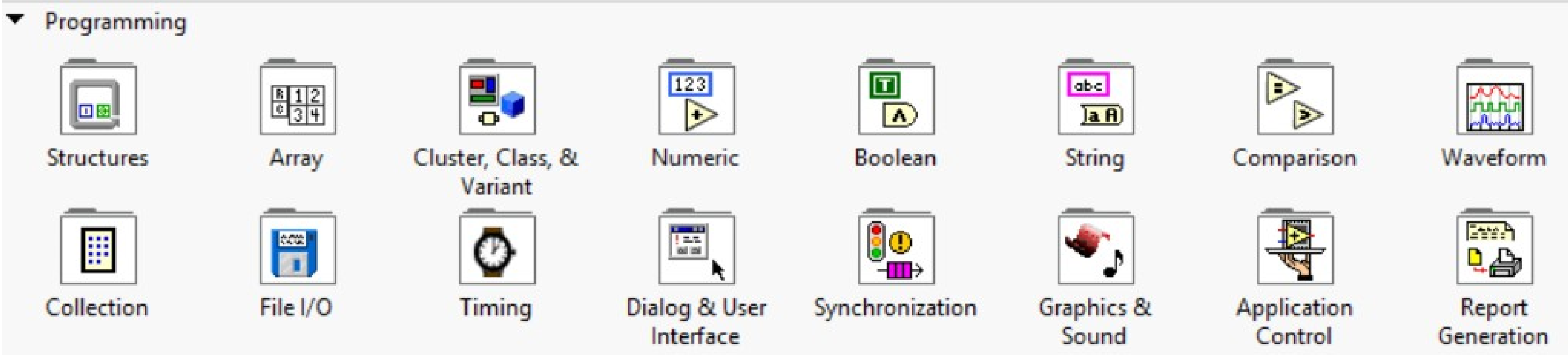
If P is unwired, the number of workers will be the number of processors in your machine.

Functional units

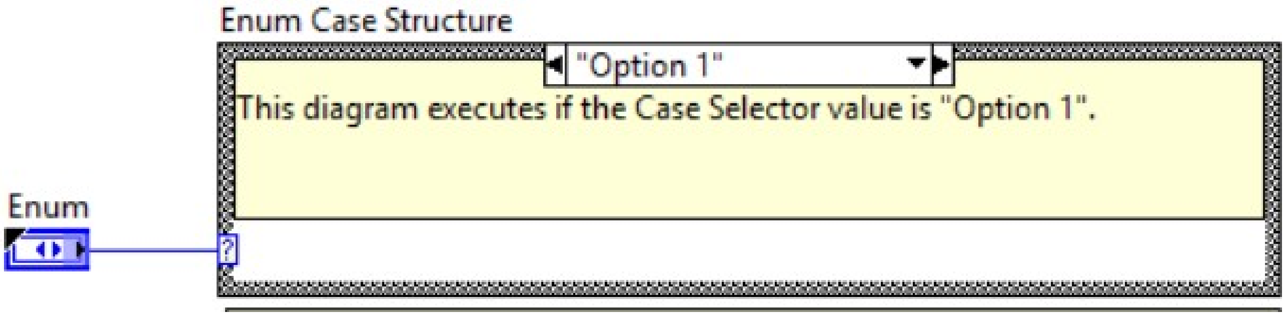
Many numeric processing elements

Multiple values can be bundled/unbundled in buses

Wires have types



Control structures and scope

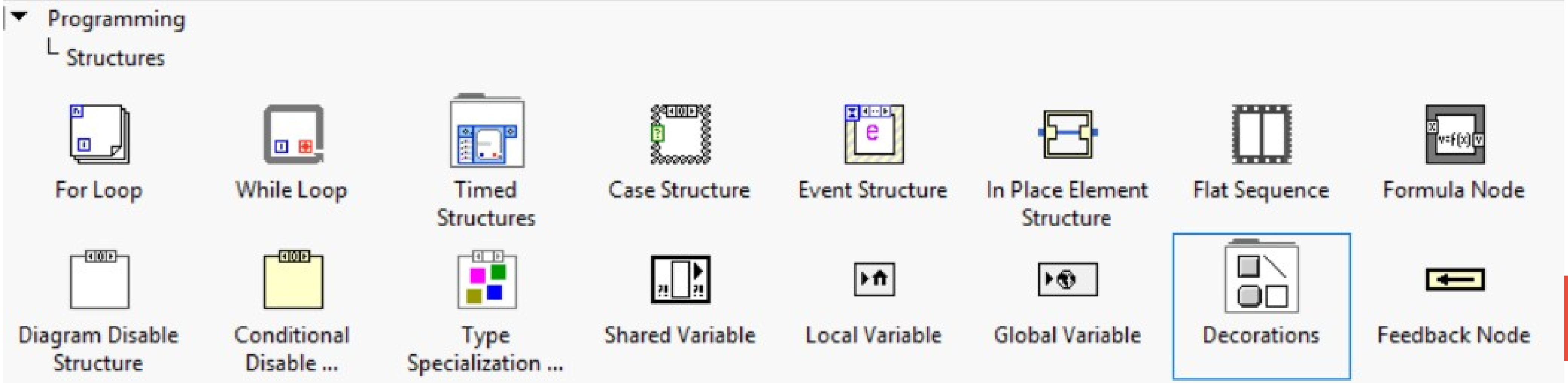


This diagram executes if the Case Selector value is "Option 1".

Control structures are represented as boxes

- on the border there is a conditional/control input connector
- the box is the equivalent of a parenthesis
- multiple cases (if-then-else, switch-case) become “pages”
- the box title contains the options
- all “pages” share the same external inputs
- control values (index) are present in all pages

There are boxes for <u>formulas</u> or <u>external code</u> (ASM/C/C++)



LabView programming style

Data-flow visual design

- Visual construction of the data-flow diagram
- Visual test of the diagram
  - all blocks have their GUI showing IN/OUT data
  - probes can be added to show <u>internal</u> wires' values

Inherently parallel (you just forget about sequentiality constraints)

Object-Oriented (classes)

Interaction with other systems:

- Function blocks for data math manipulation
- Code blocks for special algorithms
- Many libraries for Statistics, Signal analysis/manipulation, Math

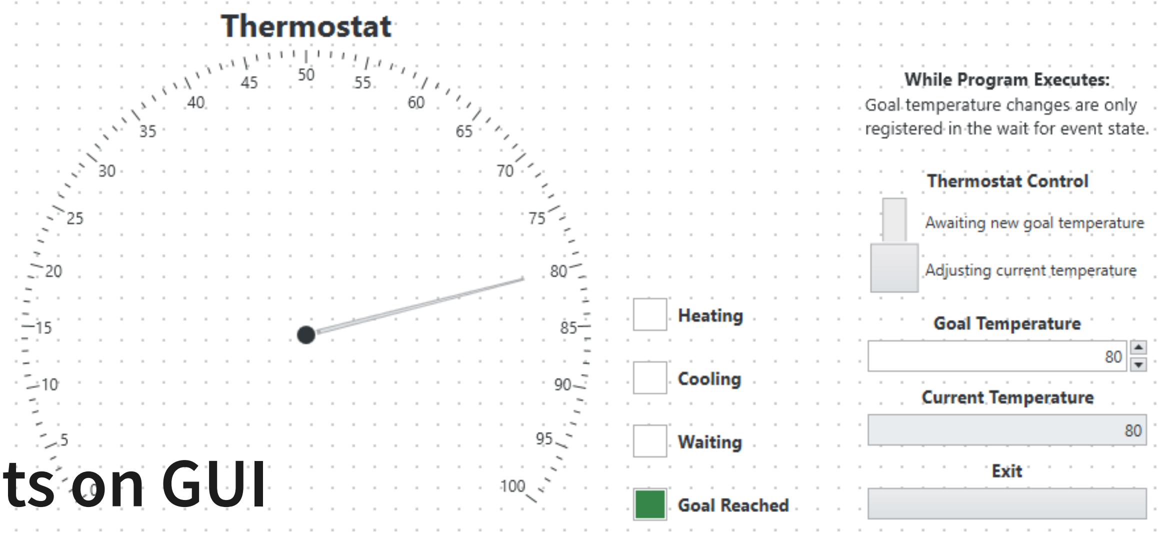
Debugging

Visual tracing of data on wires

GUI for blocks IN/OUT

Probes on wires show as widgets on GUI

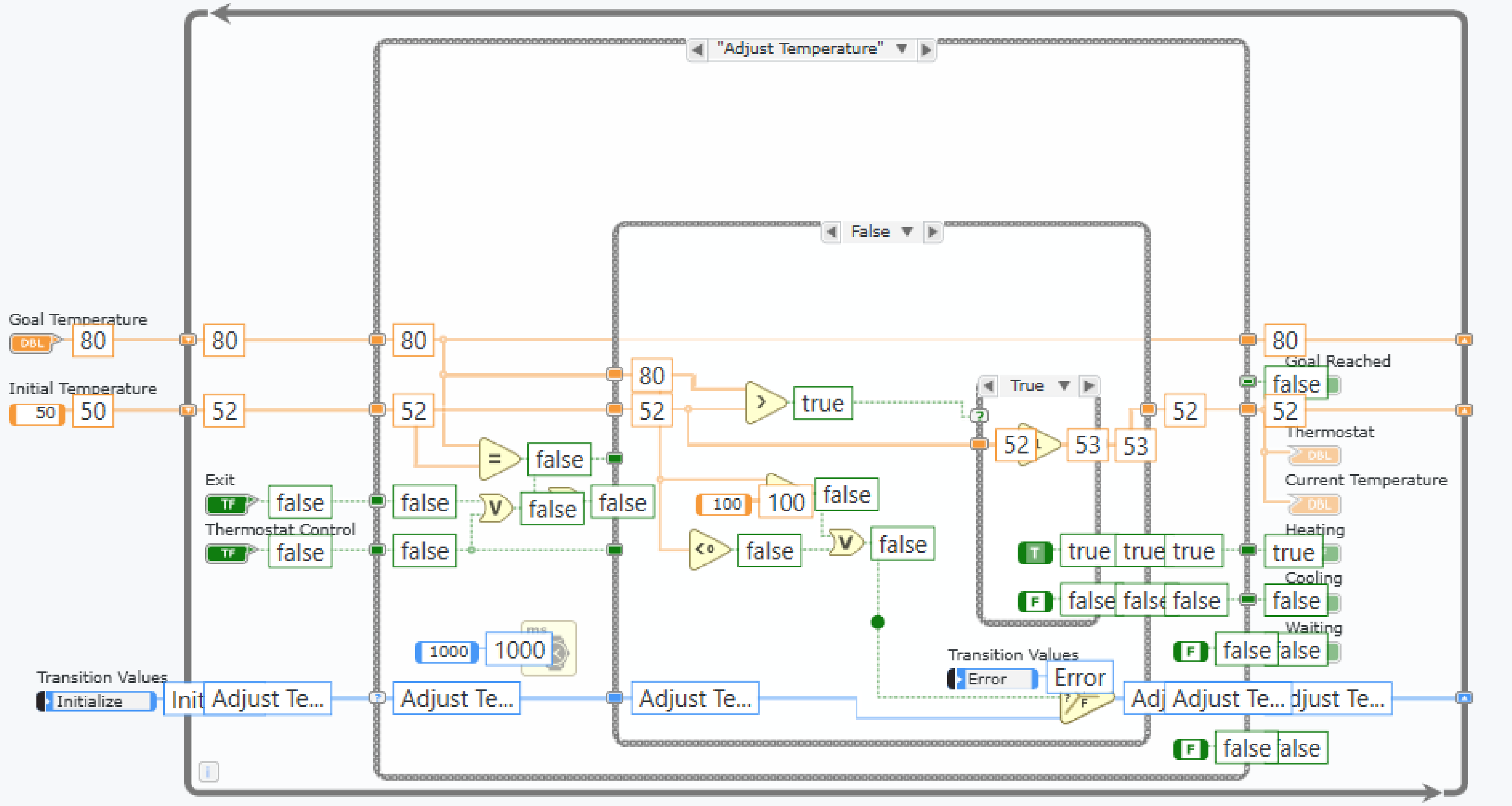
Values are shown on wires



While Program Executes:
Goal temperature changes are only registered in the wait for event state.

Goal Temperature: 80

Current Temperature: 80



Demo

DEMO