Computer Science Program, The University of Texas, Dallas

Data Flow

4.{1,2}, 3.2

Batch Sequential Pipeline Systems

Tektronix Case Study: Oscilloscope

- *1. OO model*
- *2. Layered model*
- *3. Pipe & Filter model*
- *4. Modified Pipe & Filter model*
- Formalization of Oscilloscope

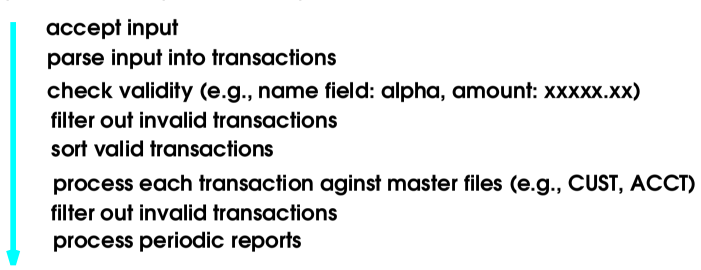
Batch Sequential Pipeline Systems

"systems where data flows linearly thru a sequence of discrete processing steps"

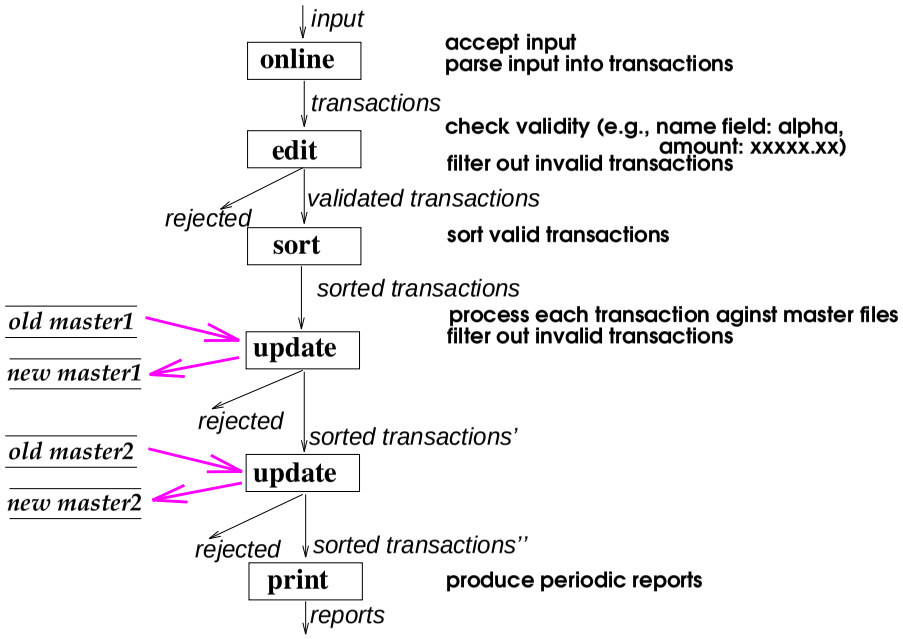
- **Early database applications**
  - transactions were collected into large batches

```
Open Acct Acct# 972883
Deposit $100 into Acct# 972883
Withdraw $1 from Acct# 972883
Withdraw $2 from Acct# 972883
Close Acct Acct# 214883
...
```

  - a small number of large stand-alone programs performed sequential updates on flat (unstructured) files.

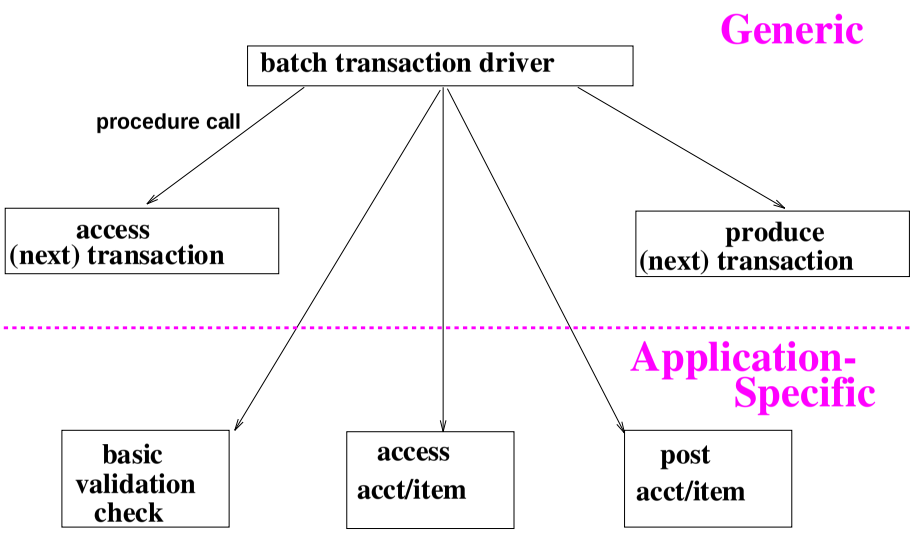


Batch Sequential Pipeline Systems



- **Constraints:**
  - processes run in a fixed sequence; but they do not know each other
  - each runs to completion, producing an output, before the next process begins

Internal Structure of Batch Update Process

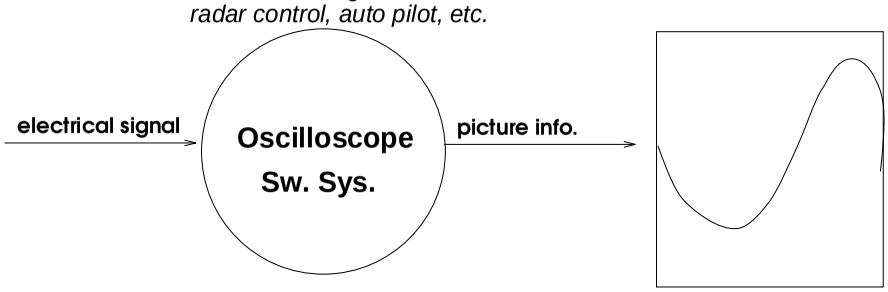


- The driver calls a different set of application-specific modules
  - for each transaction type *(e.g., no duplicates for Open Acct)*
    (e.g., no male pregnancy)
  - One for each of the master files *(e.g., CUST and ACCT)*
    (e.g., CLAIM and TREATMENT)

Tektronix Case Study

- **Background**
  - industrial development of oscilloscope SA
  - 3-year collaborative effort between several Tektronix product divisions and Computer Research Laboratory
- **Oscilloscope**

patient monitoring (ECG, EEG, EMG)
automotive diagnostics
radar control, auto pilot, etc.



  - old: simple analog device
    modern: rely primarily on digital technology, complex sw
  - **electrical signal** real-time continuous signal (in voltage)
  - **Oscilloscope** sample signals at discrete pts, measure them, display traces
    huge internal data storage, interface to a network of workstations
    sophisticated GUI, >>300 user-level commands

Tektronix Case Study

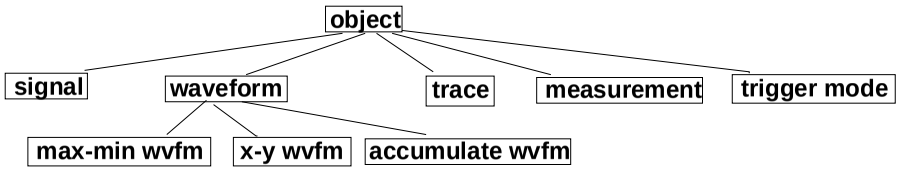
- **Needs**
  - accommodate frequent changes in hw capability
  - new reqs on UI
  - tailor general-purpose oscilloscope to specialized markets
  - better reconfigurability (how/when/where signal is acquired & displayed)
- **Problem**

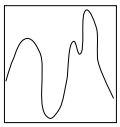
"little reuse" -> not "better, cheaper, faster, ..."

Product Division A	*development convention A* *PL A* *tool set A*
Product Division B	*development convention B* *PL B* *tool set B*
Product Division C	*development convention C* *PL C* *tool set C*

- **Goal:** develope an architectural framework
- **Result:** a domain-specific SA as the basis of the next generation oscilloscopes

An OO Model





- **waveform** a (seq. of) oscillations, in voltages, in a given time interval
- **trace** a (seq. of) oscillations, on screen, in a given time interval
- **measurement** frequency in general
  #peaks in a given segment
  max/min/avg peak
  max/min/avg rise or fall in slope
  rise/decline time
- **trigger mode** slopes greater than a given threshold value

- \+ led to a concept recognition & clarification of the data types
- \- no overall model for explaining how the types fit together

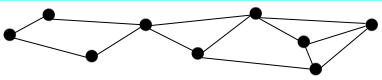
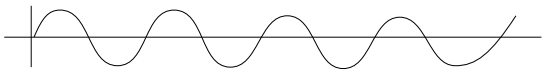
A Layered Model

User Interface	interacts with the user and decides which data to show on the screen
Visualization	manipulates saveform (incl. waveform addition) Fourier transformation (converting input signal from time domain to frequency domain) maps digitized waveforms (& measurements) to visula rep.
Digitization	digitize signals and store them internally for later processing waveform acquisition (extracting a bounded time slice of a signal)
Hardware	manipulates fns that filter signals as they enter the oscilloscope

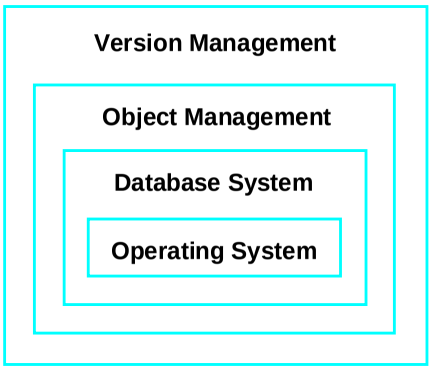
- ***Constraint***
  communication between neighboring layers only

- \+ intuitively appealing, due to partitioning of fns into well-defined groupings
- \- boundaries of abstraction conflicted with the needs for fn interactions users need to affect
  - setting channels in Hardware layer
  - choosing acquisition mode & parameters (e.g., threshold values) in Digitization layer
  - creating derived waveforms (e.g., scaling factor) in Visualization layer

OSI Reference Model

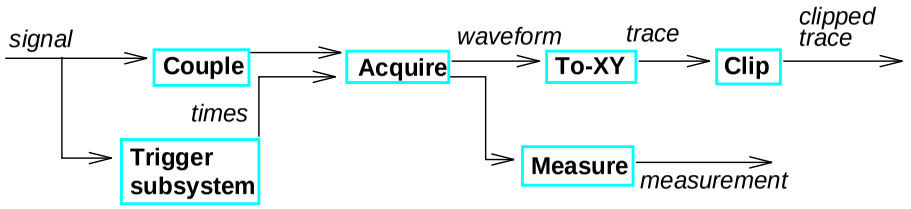
Application	email (SMTP, MIME), ftp, telnet, gopher, usenet (NNTP) , rlogin, mosaic, netscape, ...
Presentation	❁❒❋❋❊▼❋❋▼◆❒❋ ⟷ architecture Data Rep. (ASCII, EBCDIC), Compression, Encryption
Session	graceful data exchange, dialog mgmt, (re)synchronization
Transport	Split messages Quality Of Service (QOS) multiplexing
Network	 fast transmission routing accounting
Data Link	error-free transmission
Physical	

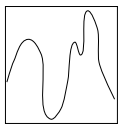
Version Management

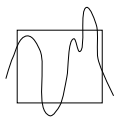


+ incremental development
+ modifiability
+ portability
- structuring can be difficult
- performance

A Pipe&Filter Model



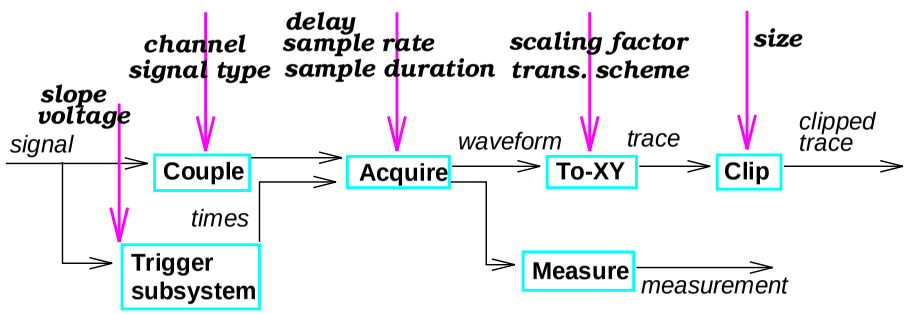


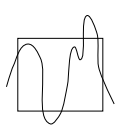


- **Couple** conditions external signals
  - DC: nothing gets changed
    AC: the value should be subtracted from the appropriate DC offset
    Ground: the voltage value = 0
- **Acquire** derive digitized waveforms from the signals, when a trigger event is detected by the Trigger subsystem
- **To-XY** converts waveforms into visual data by scaling it and positioning/translating it
- **Clip** fits the visual data into a display of certain size

- \+ intuitively appealing; well-partitioned functions, etc.
- \- interactive control difficult

A Modified Pipe&Filter Model



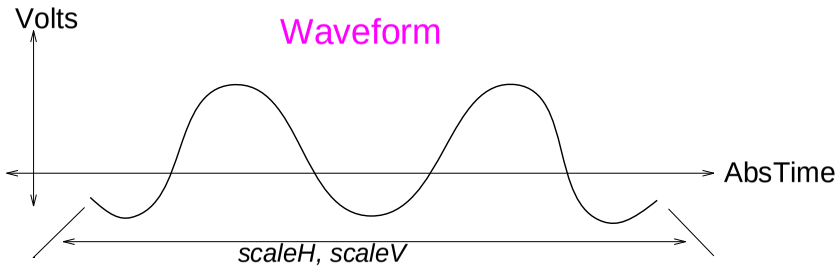


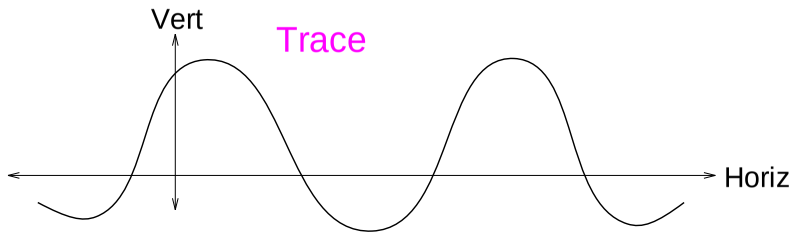
- Users dynamically control the oscilloscope by setting parameters

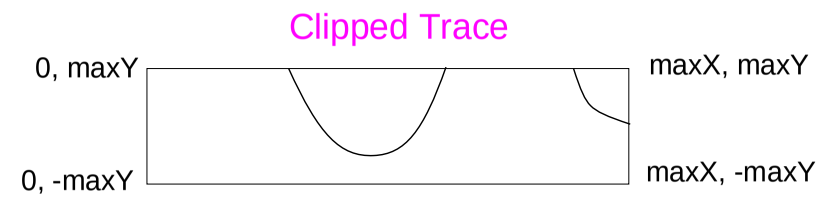
- \+ intuitively appealing; well-partitioned functions, etc.
- \+ interactive control possible

- *A 2-layer architecture*

Oscilloscope in Action -> Formalization







Lawrence Chung