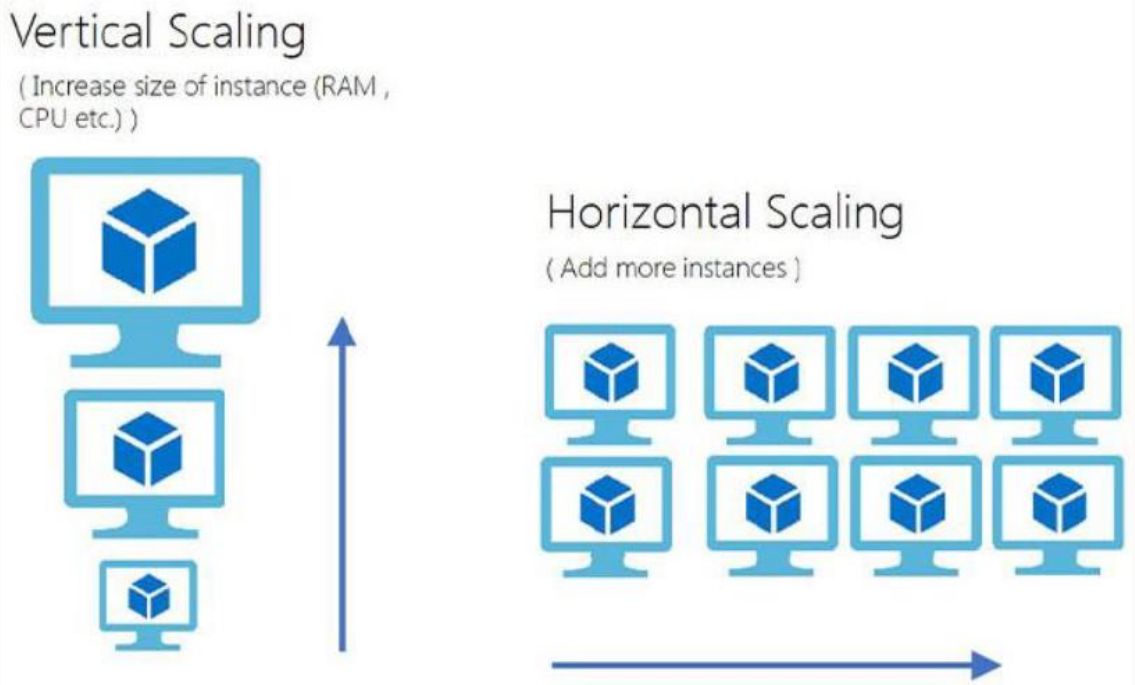
Overview of Tandem

History of Tandem Computers

- Founded in 1974
  - NonStop I finished in 1975
  - NonStop II released in 1981
- Acquired by Compaq in 1997
- In 1999, it was determined that Tandem NonStop runs
  - 90% of the world's securities trades
  - 80% of the world's ATMs
  - 66% credit card transactions
- Compaq acquired by Hewlett-Packard in 2002

Tandem NonStop

- Continuous Availability
- Unlimited Scalability
- Data Integrity



How are these Features Achieved?

- Redundancy
- Replication
- Loose Coupling
- Shared Nothing
- Message-Based Architecture
- Guardian OS (Nonstop I)
- Checkpointing

Nonstop 1

- Finished in 1975
- Process Pairs
  - Primary
  - Backup

Later Versions

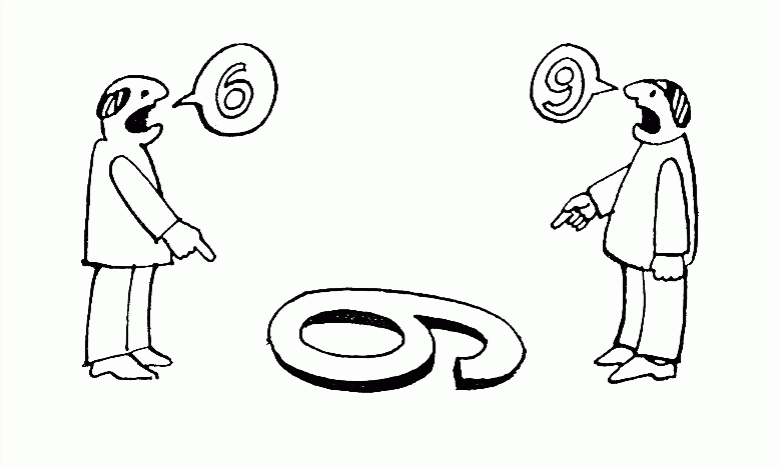
- Nonstop II
  - Released in 1981
  - Improvement of speed/memory
- NonStop TXP
  - Released in 1983
  - Doubled Speed
  - Quadrupled memory

NonStop Himalaya

- FOX – allows NonStop systems to be connected
- Himalaya
  - Finished in 1993
  - Changed underlying architecture
  - Peer-to-Peer
  - ¼ downtime of other vendors

NonStop Today

- Self-Checking Processors
- Mirroring
- Power-Failure Protection
- Identical Instruction Streams



NonStop OS

- Message-Based
- Includes the Guardian layer
- Supported Languages
  - Java
  - C
  - C++
  - COBOL
  - SCOBOL
  - TAL
  - TACL

TAL – Transaction Application Language

- Originally “Tandem Application Language”
- CISC – Complex Instruction Set Computer
- Syntax like ALGOL or PASCAL
- Semantics like C
  - No indefinite levels of nesting
  - Does not pass complex arguments by value
  - Does not strictly type most variable references

Sample ALGOL Program:

```
procedure Absmax(a) Size:(n, m) Result:(y) Subscripts:(i, k);
    value n, m; array a; integer n, m, i, k; real y;
comment The absolute greatest element of the matrix a, of size n by m,
    is copied to y, and the subscripts of this element to i and k;
begin
    integer p, q;
    y := 0; i := k := 1;
    for p := 1 step 1 until n do
        for q := 1 step 1 until m do
            if abs(a[p, q]) > y then
                begin y := abs(a[p, q]);
                    i := p; k := q
                end
end Absmax
```

Sample Pascal Program

```
while a <> b do  WriteLn('Waiting');

if a > b then WriteLn('Condition met')   {no semicolon allowed before else}
    else WriteLn('Condition not met');

for i := 1 to 10 do  {no semicolon here as it would detach the next statement}
    WriteLn('Iteration: ', i);

repeat
    a := a + 1
until a = 10;

case i of
    0 : Write('zero');
    1 : Write('one');
    2 : Write('two');
    3,4,5,6,7,8,9,10: Write('?')
end;
```

Sample TAL Programs

```
!This is a source file named MYSRC.

?SOURCE $SYSTEM.SYSTEM.EXTDECS (INITIALIZER)
                                !Include system procedure

PROC myproc MAIN;               !Declare procedure MYPROC
  BEGIN
  INT var1;                     !Declare variables
  INT var2;
  INT total;

  CALL initializer;             !Handle start-up message
  var1 := 5;                    !Assign value to VAR1
  var2 := 10;                   !Assign value to VAR2
  total := var1 + var2;         !Assign sum to TOTAL
  END;                          !End MYPROC
```

Sample TAL Programs (cont.)

```
PROC x;
  BEGIN
  INT var;
  LABEL label_one;                    !Declare a local label

  !Lots of statements
label_one :                           !Place the label at this
  var := 5;                           ! assignment statement
  !More statements
  END;
```

TACL

- Tandem Advanced Command Language
- Scripting Language
- Shell in Tandem/Nonstop computers

Sources Used

- https://cs.stanford.edu/people/eroberts/courses/soco/projects/2003-04/fault-tolerant-computing/how-tandem.html
- https://en.wikipedia.org/wiki/Tandem_Computers
- https://en.wikipedia.org/wiki/Transaction_Application_Language#:~:text=Transaction%20Application%20Language%20or%20TAL,cross%20between%20C%20and%20Pascal.
- https://en.wikipedia.org/wiki/ALGOL
- https://en.wikipedia.org/wiki/Pascal_(programming_language)
- https://en.wikipedia.org/wiki/TACL
- https://en.wikipedia.org/wiki/NonStop_(server_computers)
- https://en.wikipedia.org/wiki/Shared-nothing_architecture
- **http://nonstoptools.com/manuals/Tal-Guide.pdf**
- **https://www.hpl.hp.com/techreports/tandem/TR-91.1.pdf**