Thinking in APL: Array-oriented Solutions (Part 1)

Richard Park
Thinking in APL: Array-oriented Solutions

Tool of thought
Language & thought
Primitives
Idioms
Thinking in APL: *Array-oriented Solutions*

Array as the unit
Direct expression
Techniques
Heuristics
This Webinar

Food for thought

Secret sauce
Notation as a Tool of Thought
Iverson, K.E., 2007.

*In ACM Turing award lectures (p. 1979).*
Notation as a Tool of Thought

Ease of expressing constructs arising in problems.

Suggestivity.

Ability to subordinate detail.

Economy.

Amenability to formal proofs.
Notation as a Tool of Thought

Design Patterns vs Anti pattern in APL by Aaron W Hsu at FnConf17
https://www.youtube.com/watch?v=v7Mt0GYHU9A
Language as a Tool of Thought

Expression

Suggestivity

Subordination of detail

Economy
Economy

A Conversation with Arthur Whitney (ACM 2009)
Brian Cantrill & Arthur Whitney

AW: ... we can remember seven things.

BC: Right. People are able to retain a seven-digit phone number, but it drops off quickly at eight, nine, ten digits.

AW: If you’re Cantonese, then it’s ten. I have a very good friend, Roger Hui, who implements J. He was born in Hong Kong but grew up in Edmonton as I did. One day I asked him, “Roger, do you do math in English or Cantonese?” He smiled at me and said, “I do it in Cantonese because it’s faster and it’s completely regular.”
APL Thinking?

*The thought process of someone using APL*

- Primitive functions and operators
- Translating natural language algorithm descriptions
- Translating pseudo code
- Translating code from another programming language
- Translating mathematical formulae
- Specific techniques
- Problem solving heuristics
APL Thinking?

The thought process of someone using APL

- Primitive functions and operators
- Translating natural language algorithm descriptions
- Translating pseudo code
- Translating code from another programming language
- Translating mathematical formulae
- Specific techniques
- Problem solving heuristics
Pragmatism: Array-oriented Solutions?

Array as a unit
Array as a unit

Example: Counting elements

∇ t←Count array;element

[1] t←0
[3] t+←1
[4] :EndFor

∇
Array as a unit

*Example: Counting elements*

```
{⍺←0 ⋄ 0=⍴⍵:⍺ ⋄ (⍺+1)∇1↓⍵}
{+/⍵=⍵}
```

```
Array as a unit

**Example:** Counting elements

\[
\{ \alpha \leftarrow 0 \land 0 = \rho \omega : \alpha \land (\alpha + 1) \nabla 1 \downarrow \omega \}
\]

\[
\{ +/ \omega = \omega \} \land +/ = \sim \land \neq
\]
Array as a unit

**Example: Selection**

∇ vowels←JustVowels word
[1]  vowels←''
[2]  :For letter :In word
[3]  :If letter∊'aeiou'
[5]  :EndIf
[6]  :EndFor

∇
Array as a unit

*Example: Selection*

'aeiou'{(ω∈α)/ω}word
Array-oriented Solutions


Knowing and using

Primitives
Idioms
Techniques
Heuristics
Primitives
Language bar
Idioms

Jul 2nd  
16:00 BST  
aplcart.info turns 1

Adám Brudzewsky demonstrates the various features of APLcart, the largest-ever collection of short APL phrases.

Search: BAA webinar schedule 2020
BAA live webinars, 7pm every Wednesday

*** Next webinar: 7pm BST, Wed 1 July ***
Is SS Cygni losing the plot? Observing unusual outbursts in a well-known dwarf nova - Dr Jeremy Shears, Director of the BAA Variable Star Section

Connect using Zoom - https://us04web.zoom.us/j/548739039 - or via the BAA YouTube channel
Webinar Schedule for 2020

Posted by John Jacob | Apr 15, 2020 | Events, News

The British APL Association is now holding a series of bi-weekly webinars via Zoom. See the published Webinar Schedule for details of up-coming events.

Due to the COVID-19 outbreak BAA London has
Techniques

\{ f \# \alpha \ g \ \omega \} \\
\{ (\alpha \ f \ \omega) \# \omega \}
Heuristics

Metzger, R.C., 1981.

APL thinking finding array-oriented solutions.

*ACM SIGAPL APL Quote Quad, 12(1), pp.212-218.*
Heuristics

Metzger, R.C., 1981.

APL thinking finding array-oriented solutions.

1) Value First, Then Shape;
2) Shape First, Then Value;
3) Data Transformation;
4) Loop First;
5) Think Big;
6) Function Listing;
7) Synonym Search.
Value First

*Example:* To
Value First

$$3\{(a-1) \downarrow \imath \omega\}7$$

3 4 5 6 7
Value First

Filtering

\[3\{\alpha \leq i\}/i \leftarrow i \omega\}7\]

3 4 5 6 7
Shape First

$$3\{(\alpha-1)+i1+\omega-\alpha\}7$$

3 4 5 6 7
Value First

\[ \text{Miota} \leftarrow \{ \right. \]

\[ \quad \text{max} \leftarrow \max / \omega \]

\[ \quad i \leftarrow \iota \text{max} \]

\[ \quad n \leftarrow (\rho \omega, \text{max}) \rho i \]

\[ \quad (\omega \circ \geq i) / , n \]

\[ \} \]

\[ \text{MIota} \ 4 \ 2 \ 3 \]

\[ 1 \ 2 \ 3 \ 4 \ 1 \ 2 \ 1 \ 2 \ 3 \]
Shape First

Miota2 ← {  
i ← (+/ ω) ⍵ 1  
i[1+/−1↓ω] ← 1−1↓ω  
+\i  
}

MIota 4 2 3
1 2 3 4 1 2 1 2 3
Shape First

\[
\text{Miota}\ 3 \leftarrow \{
\begin{align*}
  i & \leftarrow (+/\omega) \rho 1 \\
  +\backslash (1-1\downarrow\omega) @ (1++\backslash-1\downarrow\omega) & \leftarrow i
\end{align*}
\}
\]
Language as a Tool of Thought

“the computer language you use influences how you understand and solve problems”

Linguistic Determinism

“the language you use influences how you understand” – me just now

Linguistic Determinism

Search: Sapir-Whorf Hypothesis

Radiolab Words

APL Thinking

Array-oriented Solutions

Primitives
Idioms
Techniques
Heuristics
Next Week

Jul 2nd  16:00 BST  aplcart.info turns 1

Adám Brudzewsky demonstrates the various features of APLcart, the largest-ever collection of short APL phrases.

Search: BAA webinar schedule 2020
Next Dyalog Webinar

Jul 9th  16:00 BST

Adám presents

Language Features of Dyalog version 18.0 in Depth (part 3)