



INCREMENTAL DIALOGUE SYSTEMS

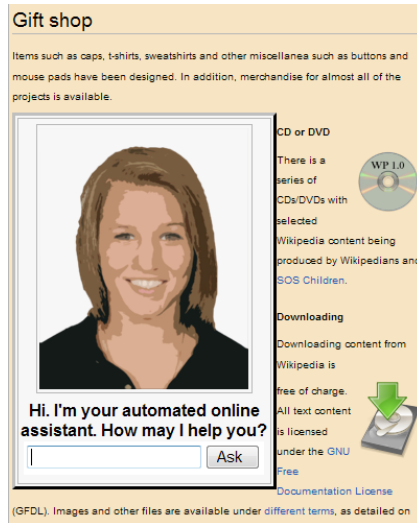
**The work of David Schlangen, Gabriel Skantze
and Anna Hjalmarsson presented by Fai Greeve**

TODAY:

- Dialogue systems: Why? Which are out there? What difference does incrementality make?
- Incremental dialogue systems: Which topology, how does the information flow and how do the modules process information?
- Incremental dialogue systems: Implementation examples. How do they perform?

DIALOGUE SYSTEMS

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Watch it at: <http://www.youtube.com/watch?v=YBuaZHZ29Ko>

AN IN-CLASS EXPERIMENT

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System 1:

○ 2 7 9 45 89 67 0 9

System 2:

○ 64 3 6 9 22 19 9 2

- Did you succeed in the task?
- How well were you understood?
- How responsive was the system?
- Did the system behave as expected?
- How humanlike was the system?
- Which system did you prefer?

AN EXAMPLE DIALOGUE BETWEEN A USER AND THE NUMBERS SYSTEM

U.01 **two five three -**

S.02 *okay*

U.03 **one forty, five -**

S.04 *sorry, do you mean one and then forty and then five?*

U.05 **no, one forty five**

S.06 *okay, one forty five*

U.07 **yeah, and six eight four -**

S.08 *okay*

U.09 **seven twelve nine.**

S.10 *so, from the start, two five three -*

U.11 **yeah**

S.12 *one forty five six six four -*

U.13 **no, six eight four**

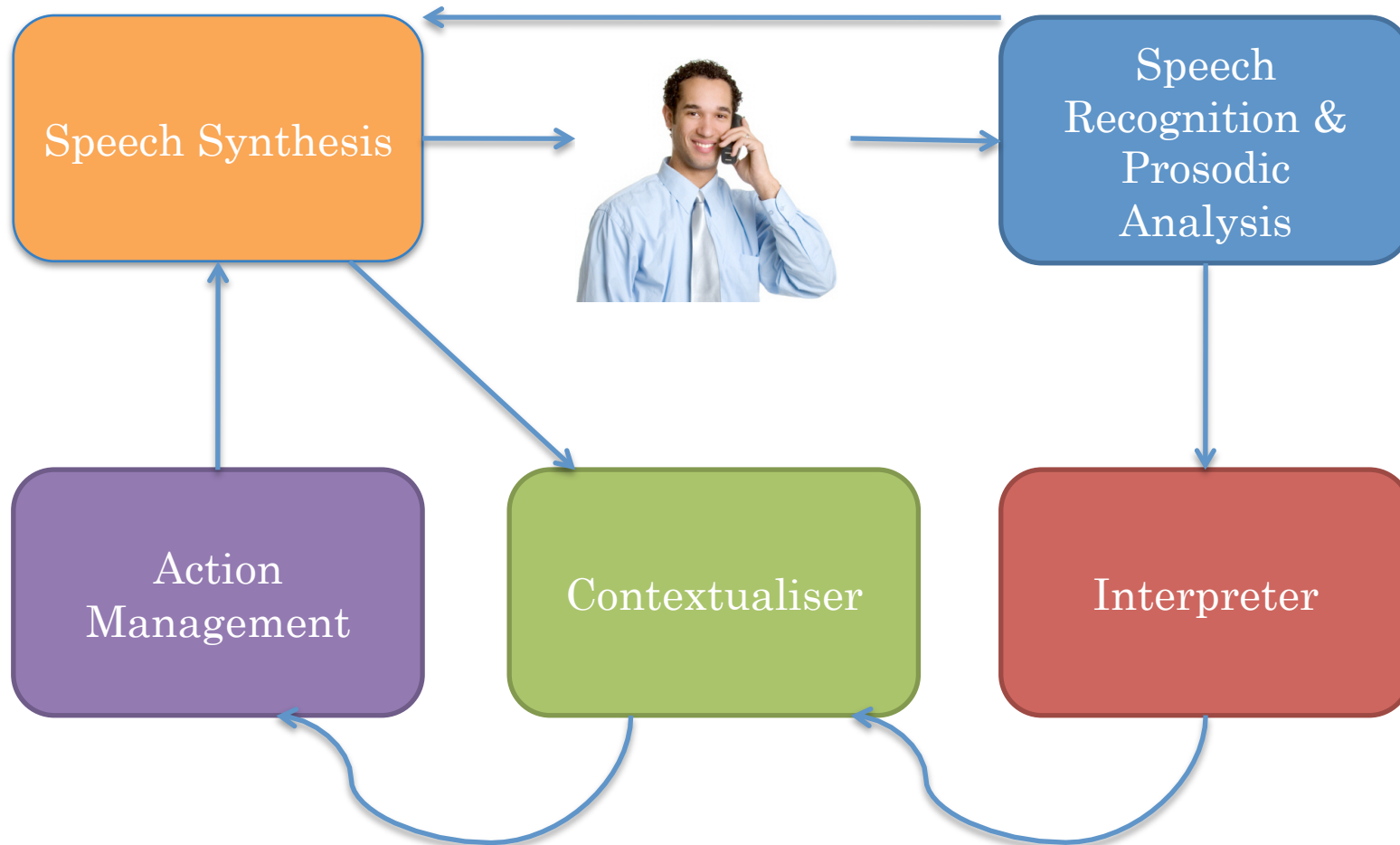
S.14 *okay, six eight four and then seven twelve nine.*

U.15 **that's right**

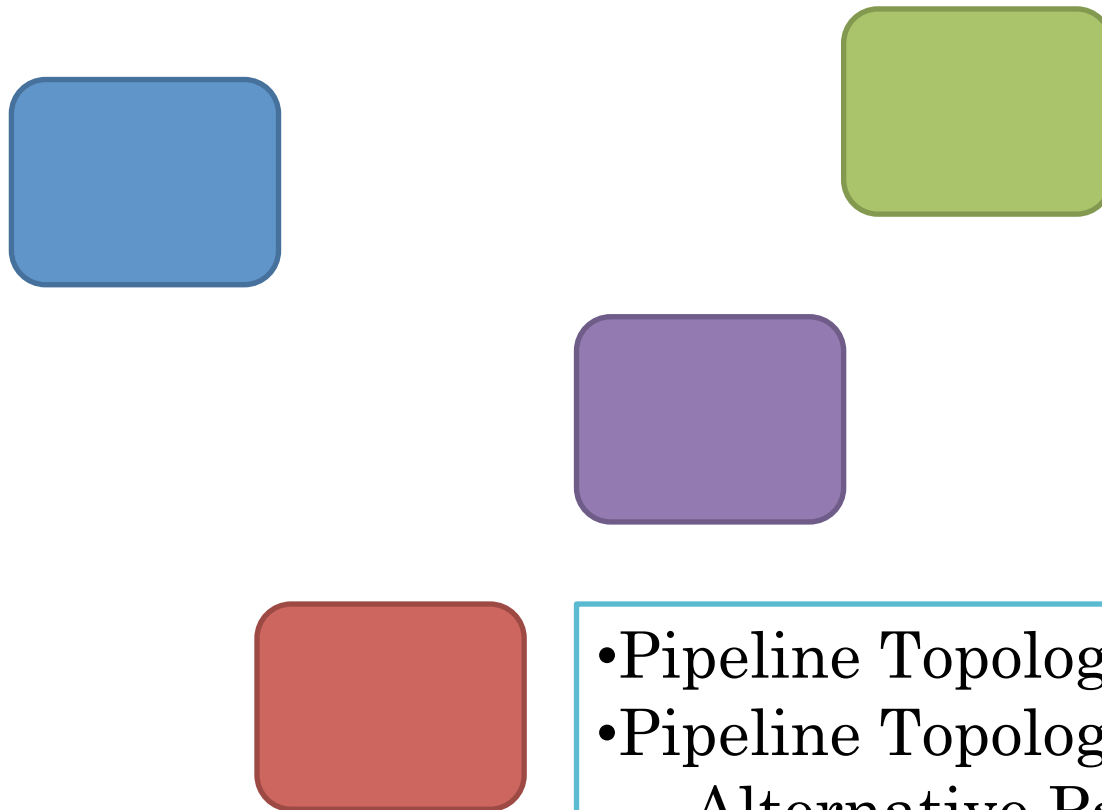
INCREMENTALITY

- Proceed in steps
- Processing starts before the input is complete, and the first output is produced as soon as possible
- Trade-off: responsiveness vs output quality

NUMBERS

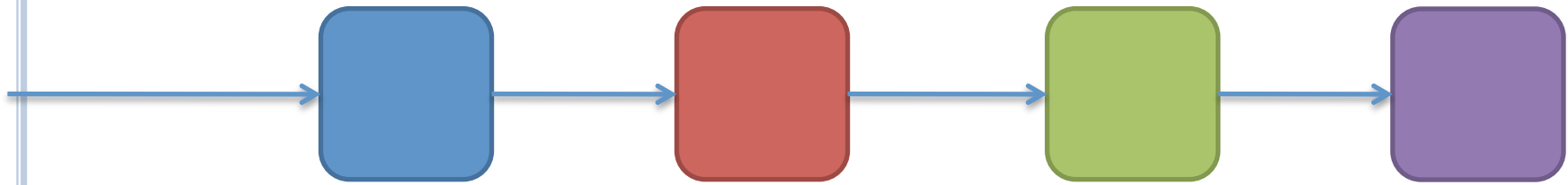


TOPOLOGY



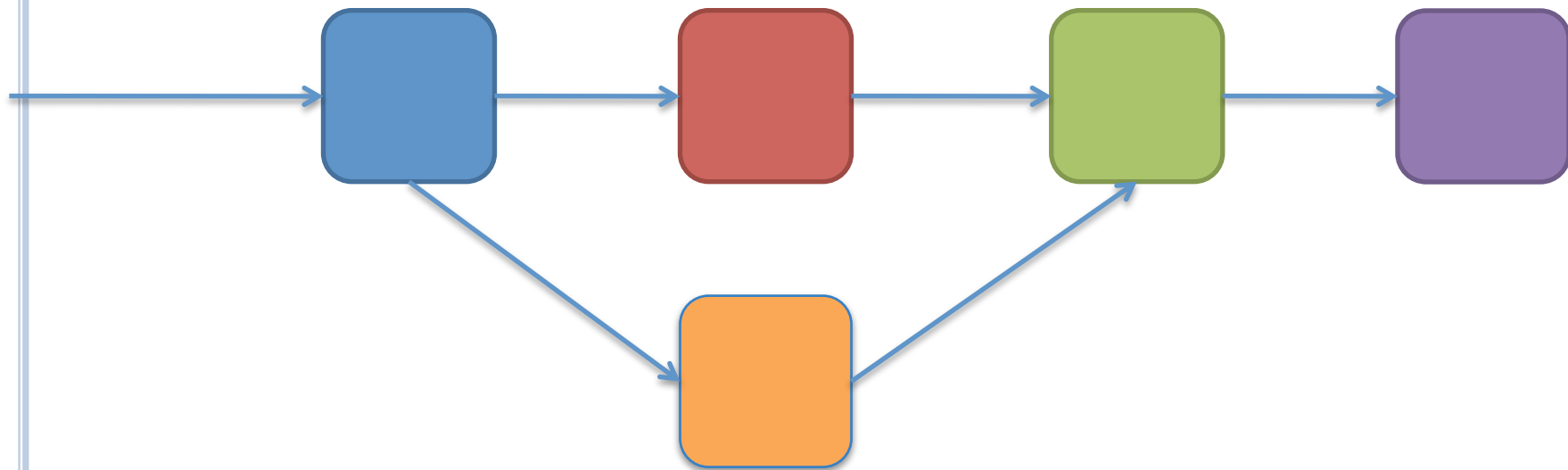
- Pipeline Topology
- Pipeline Topology + Alternative Paths
- Star Topology

PIPELINE TOPOLOGY



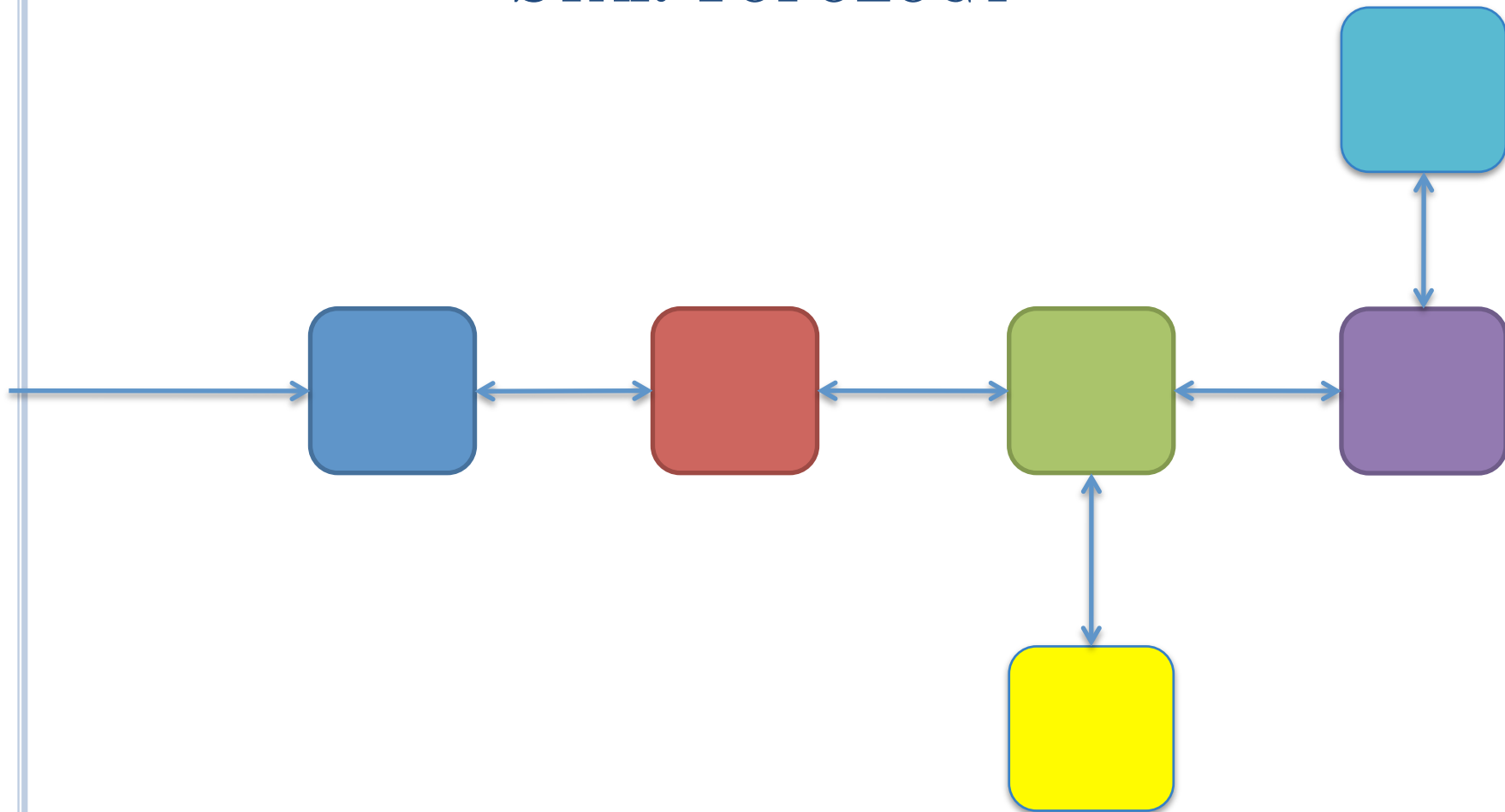
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PIPELINE TOPOLOGY + ALTERNATIVE PATH



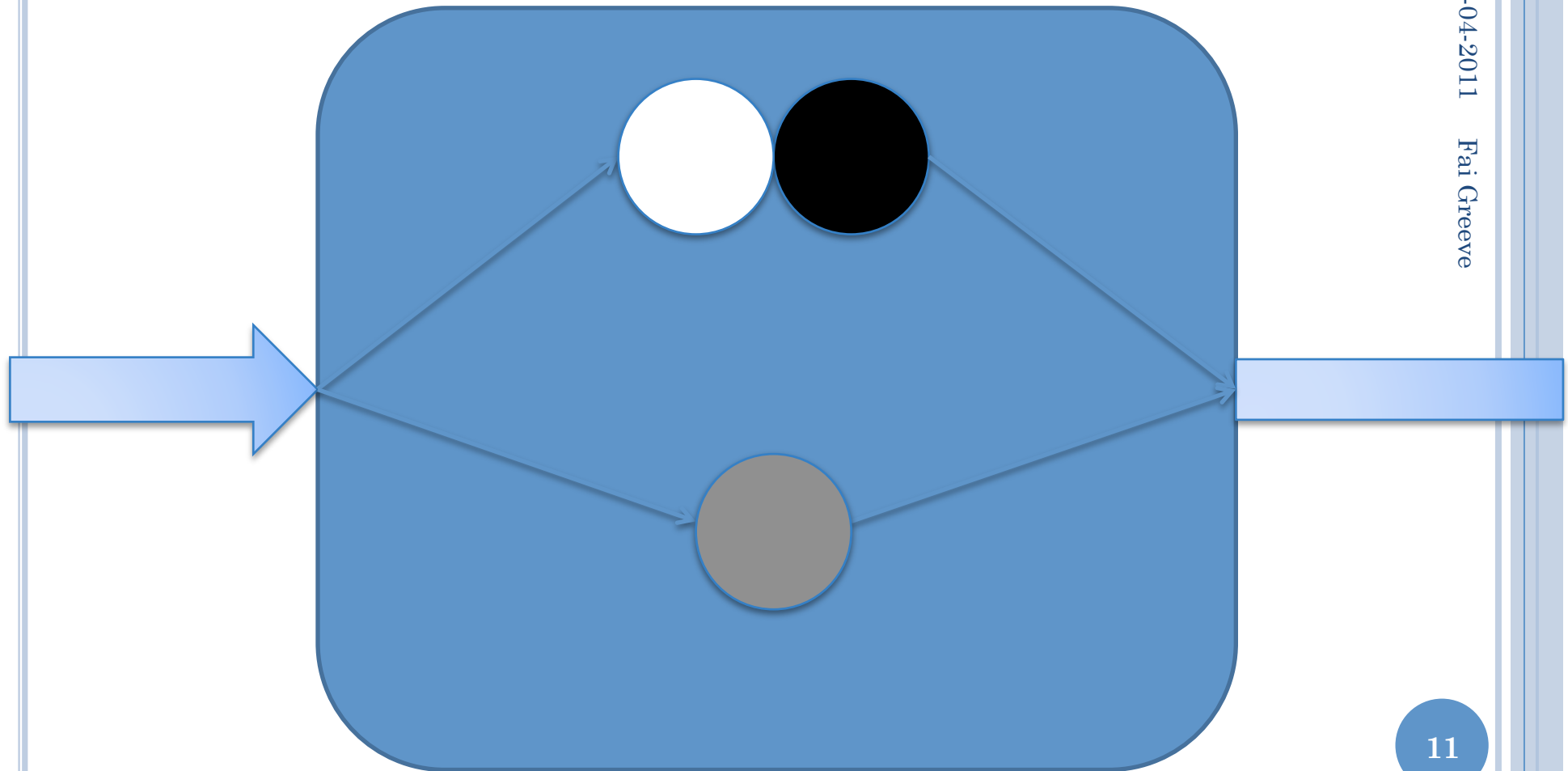
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STAR TOPOLOGY




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PARALLEL INFORMATION

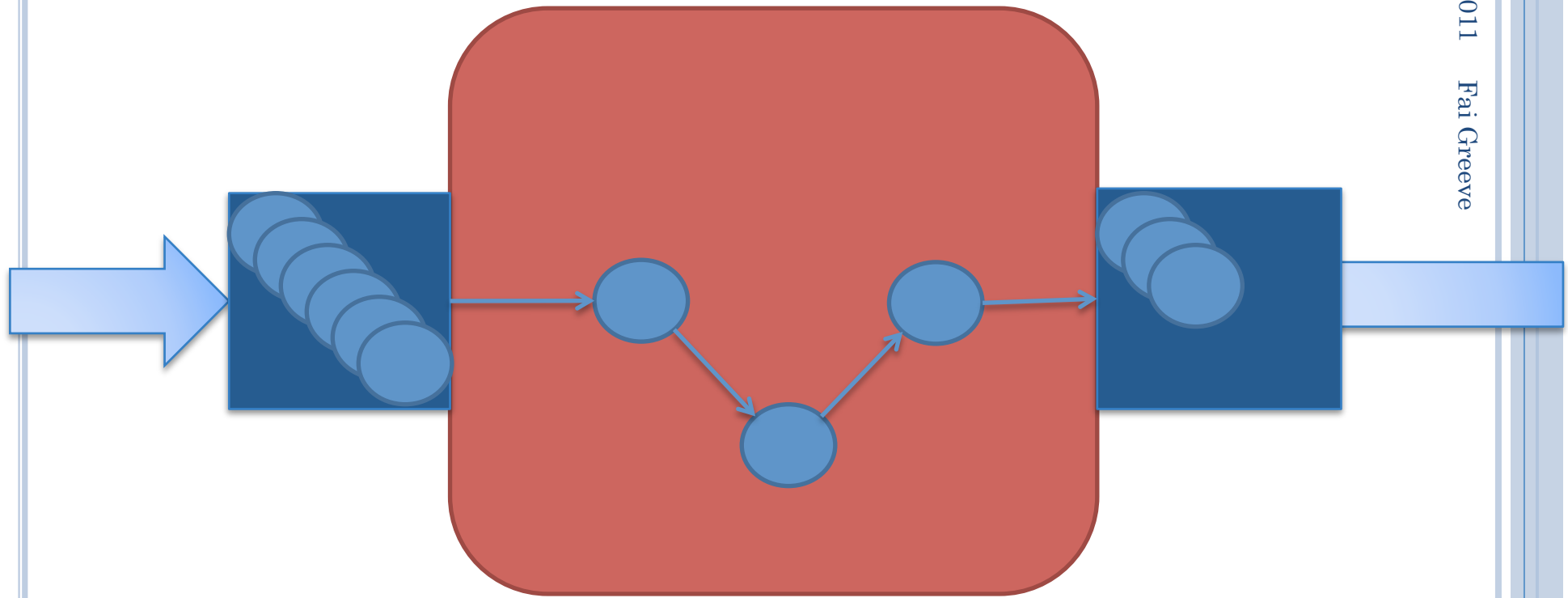


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INCREMENTAL UNIT

Identifier: ID567
Same Level Link: ID566s (nine)
Grounded in: ID476 ()
Confidence: 0.8
Committed: T
Seen: SR
Payload: two

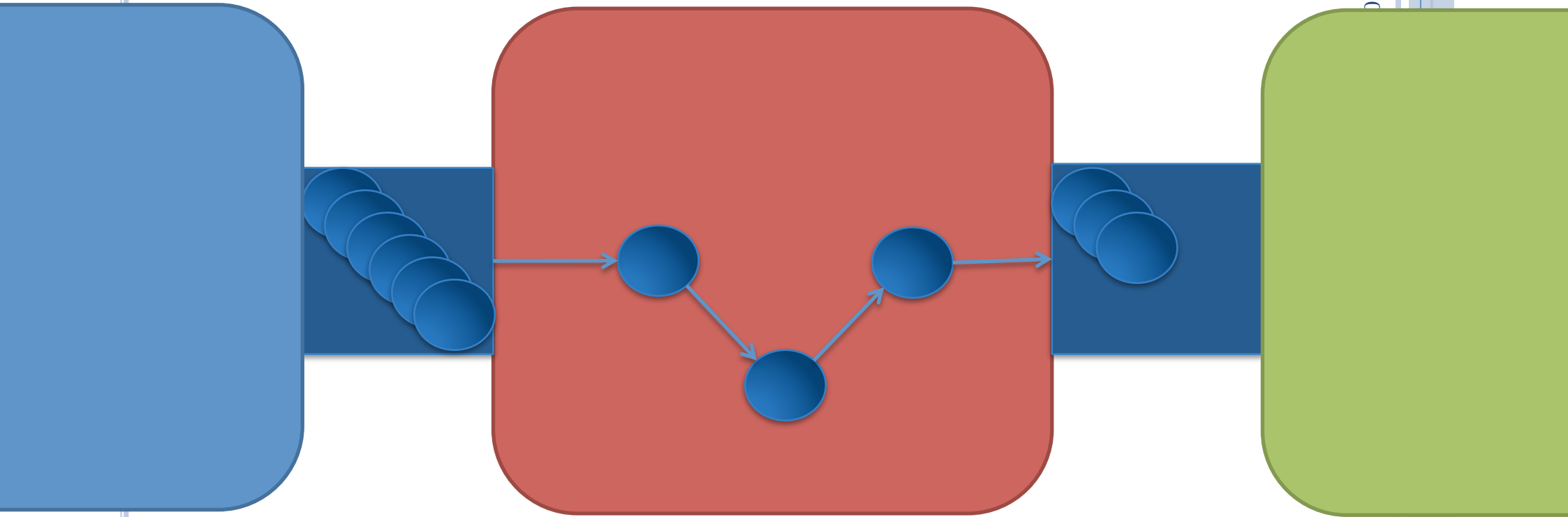
LEFT BUFFER – PROCESSOR – RIGHT BUFFER



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CONNECTED AXIOMS

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MODULE BEHAVIOUR

**Update
Frequency**

f: in = out

f: in \geq out

f: in \leq out

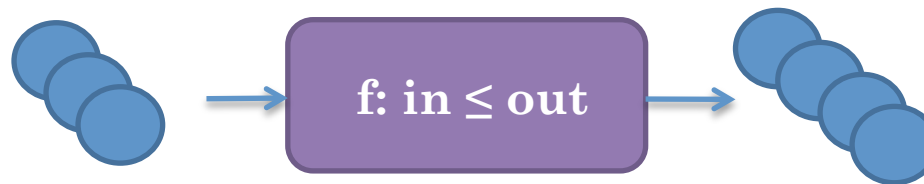
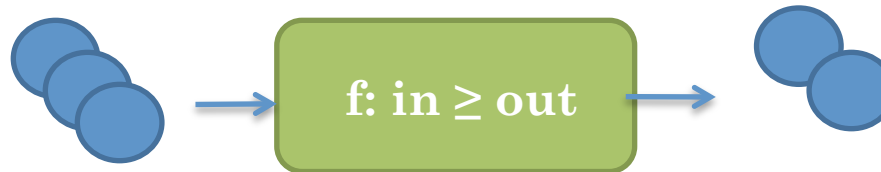
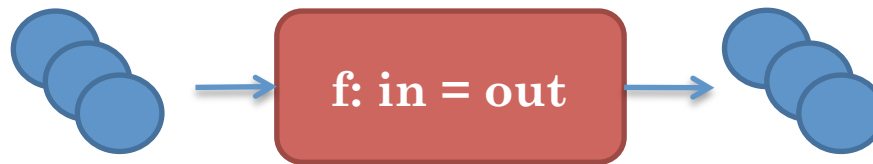
Connectedness

Completeness

c: in = out

c: in \geq out

c: in \leq out

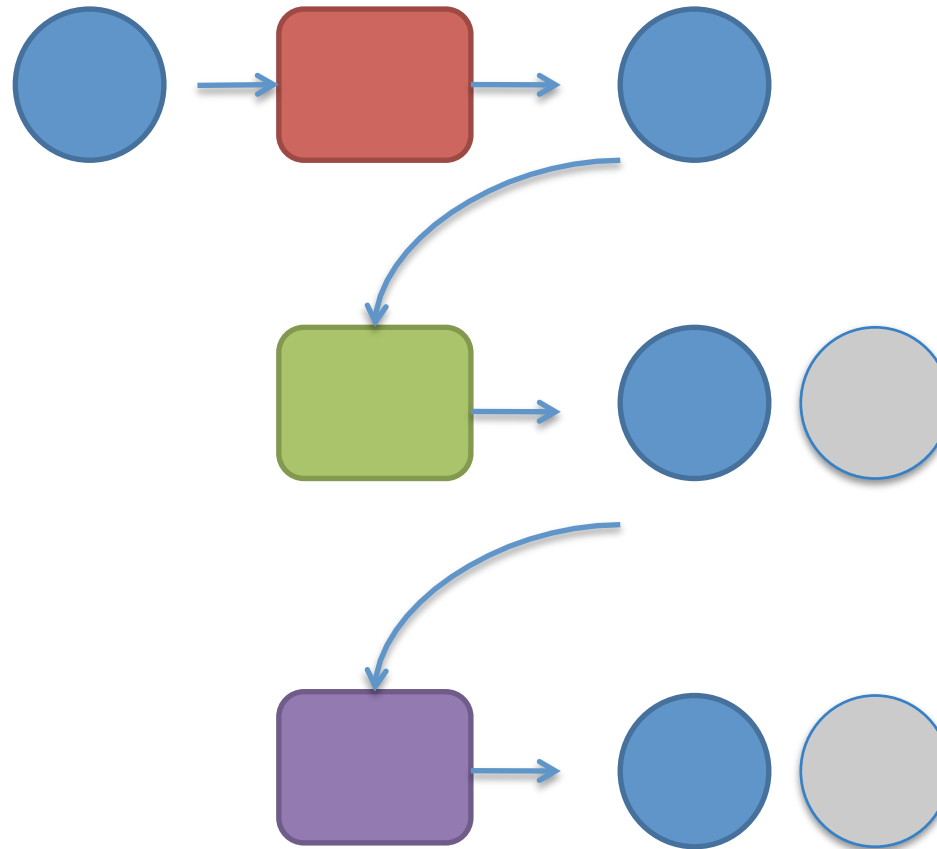


MODULE BEHAVIOUR

Update
Frequency
 $f: \text{in} = \text{out}$
 $f: \text{in} \geq \text{out}$
 $f: \text{in} \leq \text{out}$

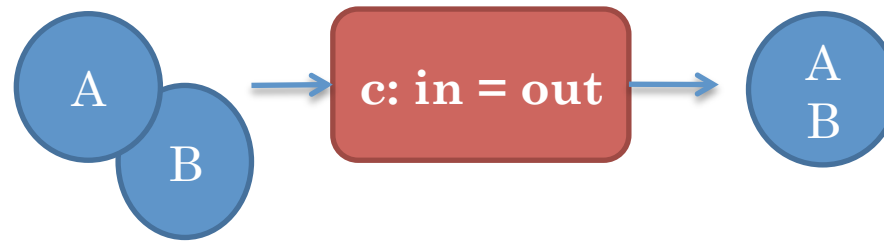
Connectedness

Completeness
 $c: \text{in} = \text{out}$
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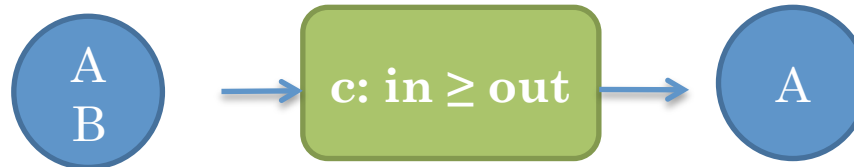


MODULE BEHAVIOUR

Update
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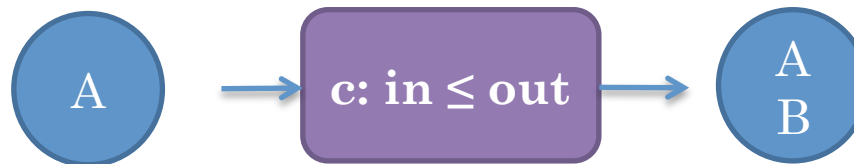


Connectedness

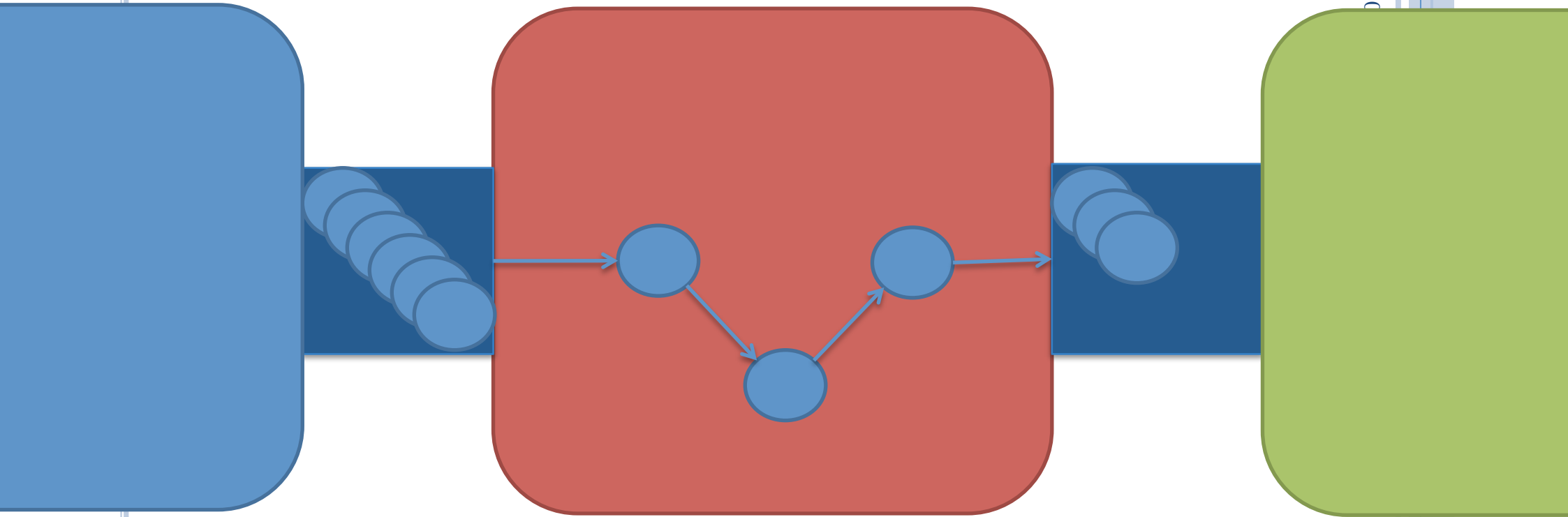


Completeness

$c: \text{in} = \text{out}$
 $c: \text{in} \geq \text{out}$
 $c: \text{in} \leq \text{out}$



MODULE OPERATIONS: UPDATE PURGE COMMIT



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MODULE OPERATIONS:

UPDATE PURGE COMMIT

  **FOUR**

 **FOUR**

  **FORTY**

FOUR FORTY

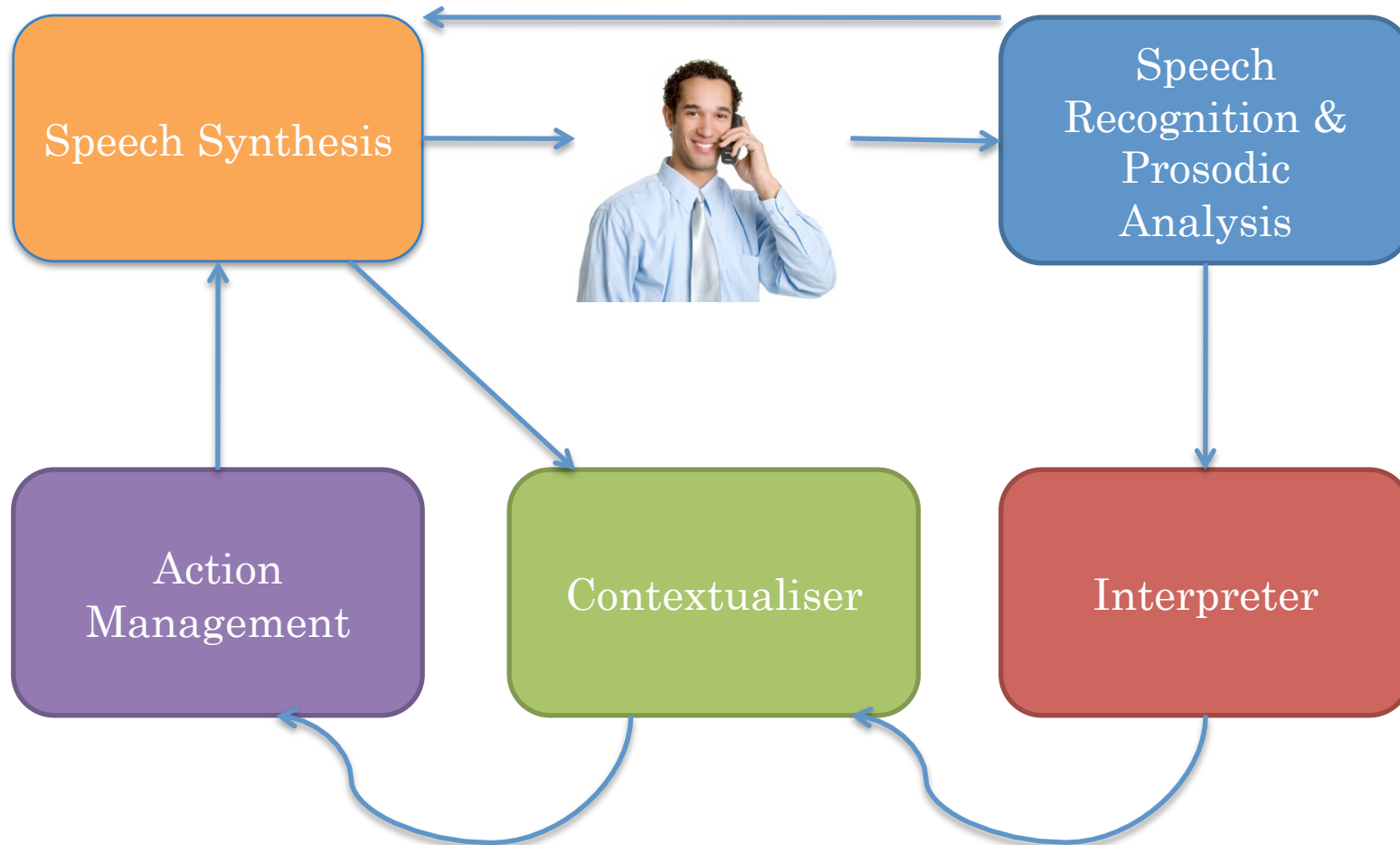
  **FORTY FIVE**

FORTY FIVE

 **FORTY FIVE**

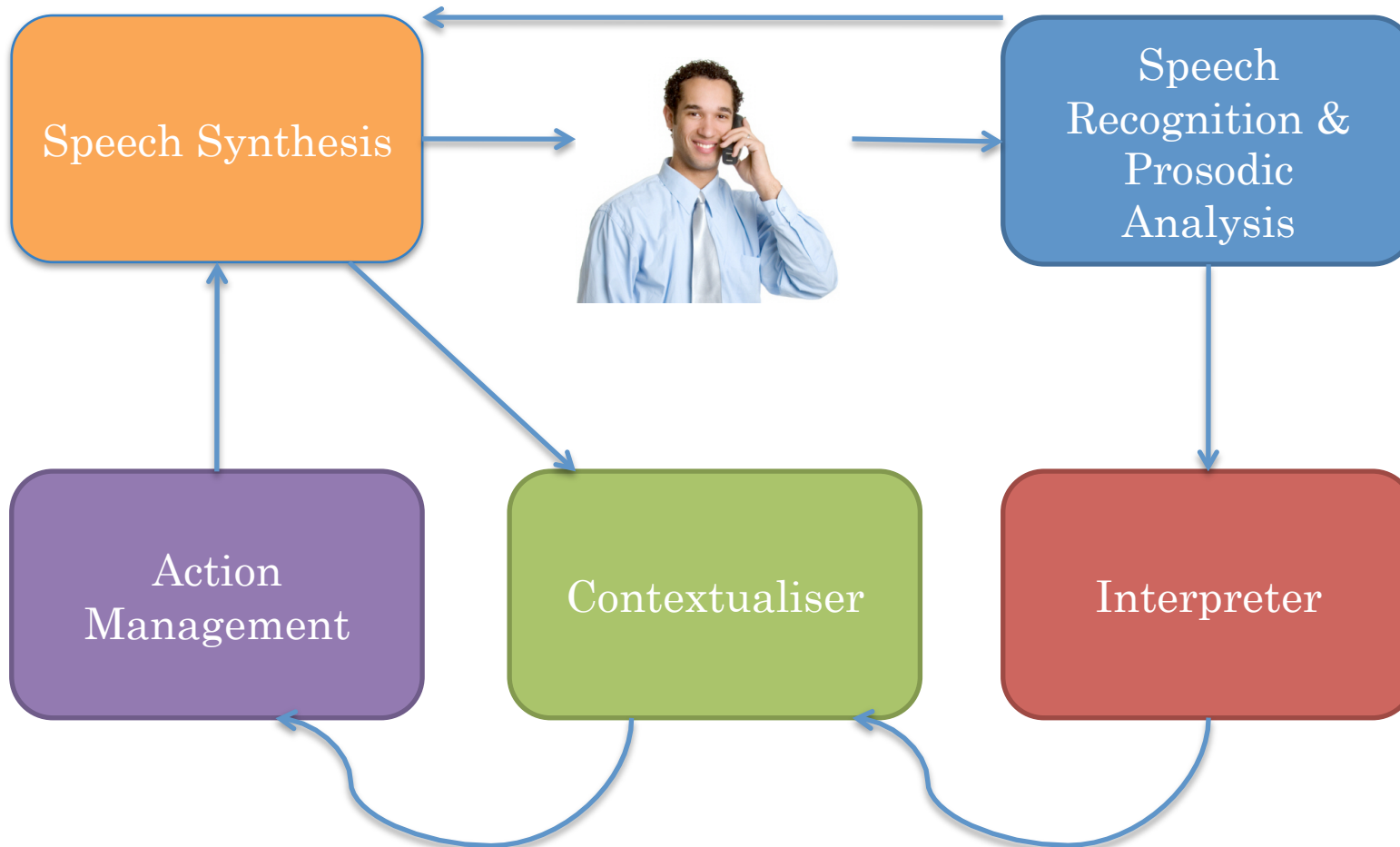
FORTY FIVE

NUMBERS



NUMBERS

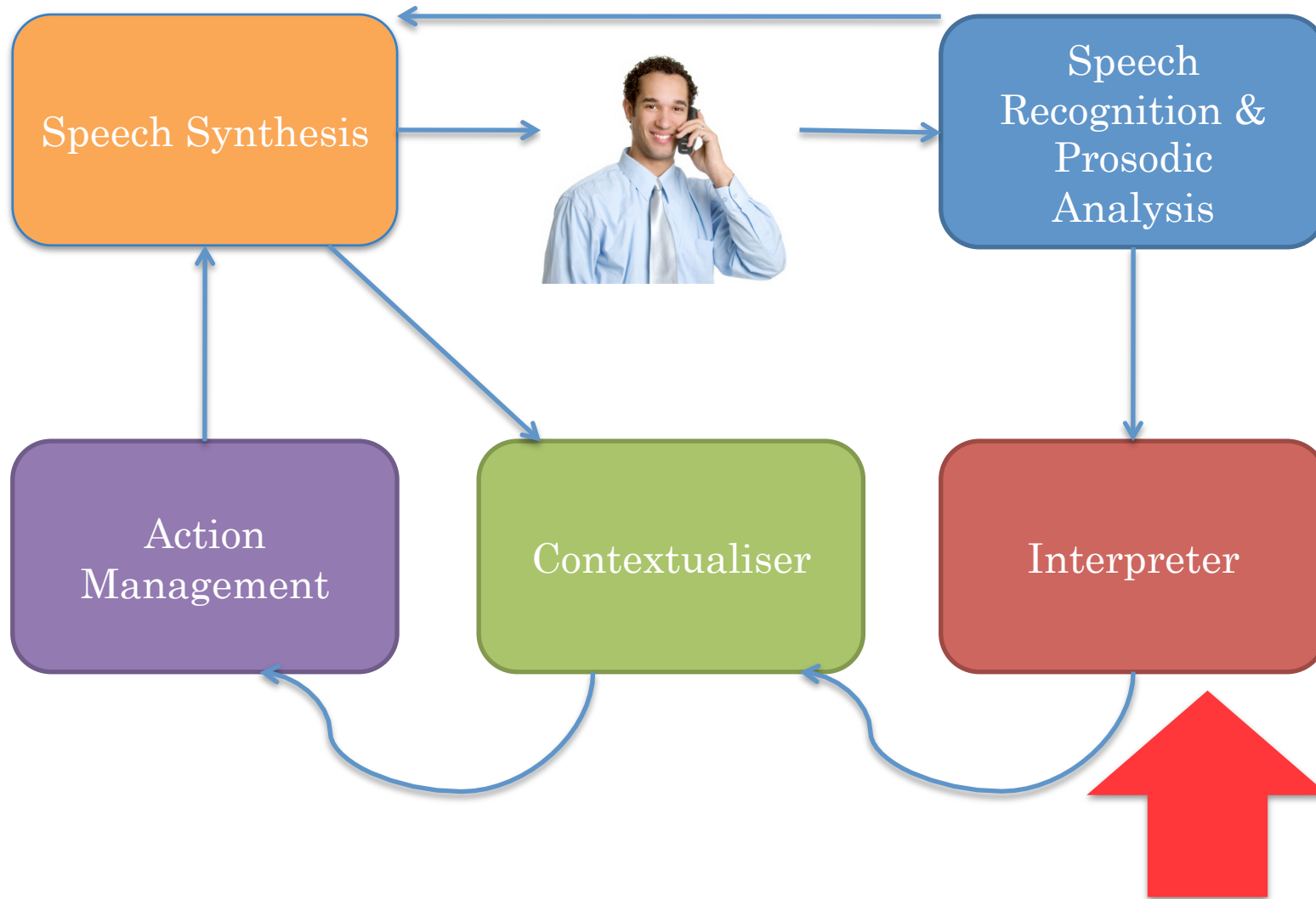
SPEECH RECOGNITION & PROSODIC ANALYSIS



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NUMBERS

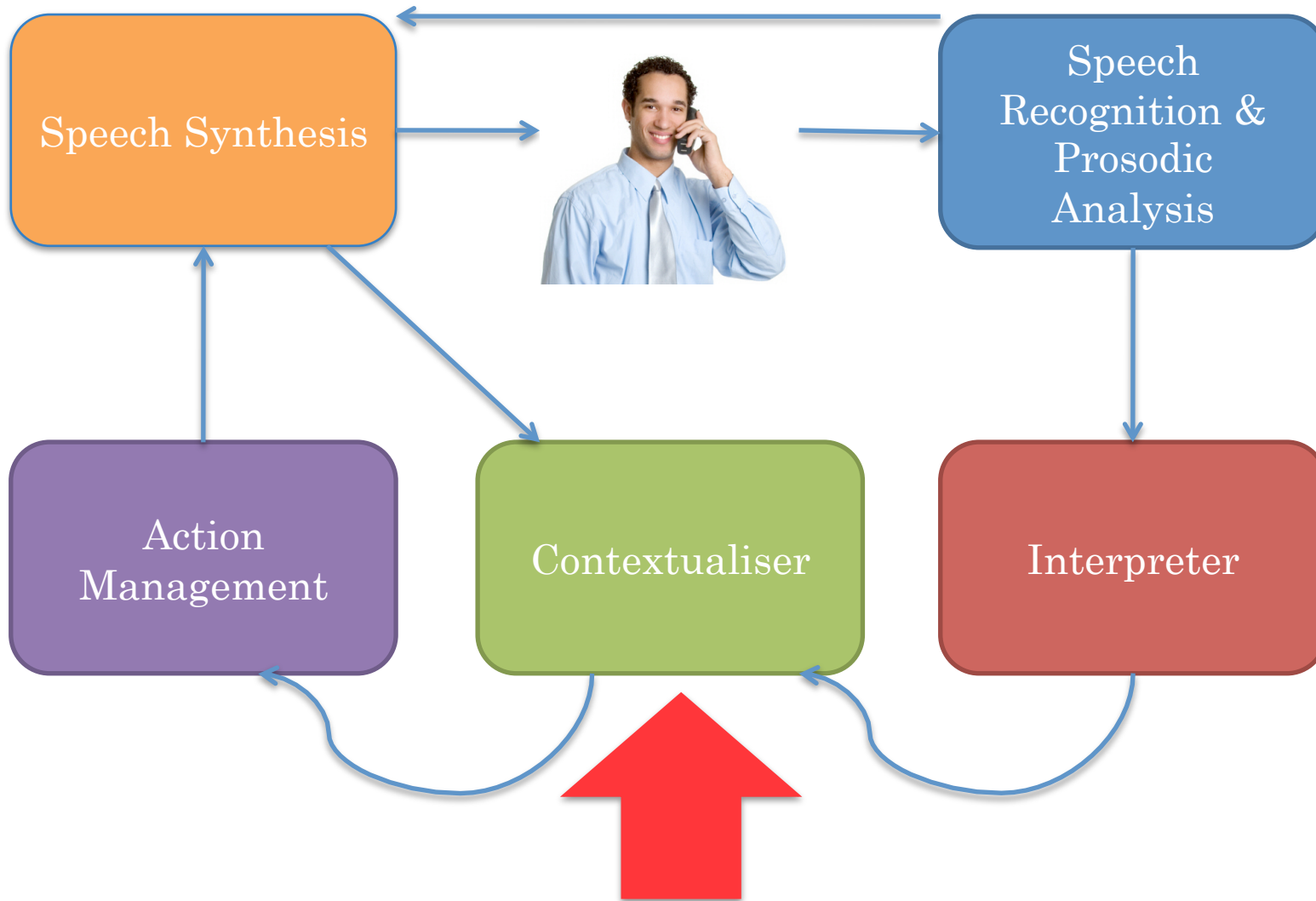
INTERPETER



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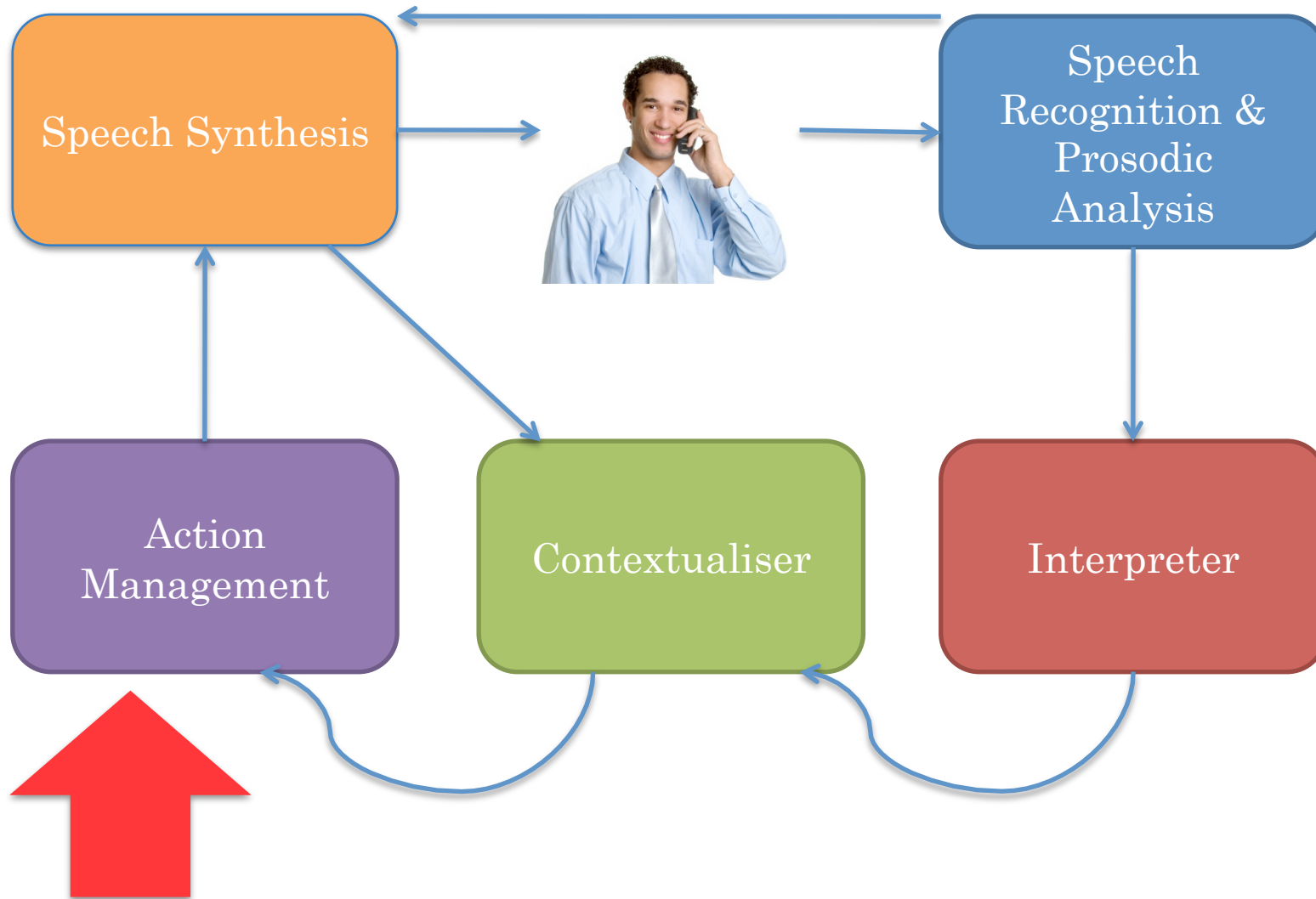
NUMBERS

CONTEXTUALISER



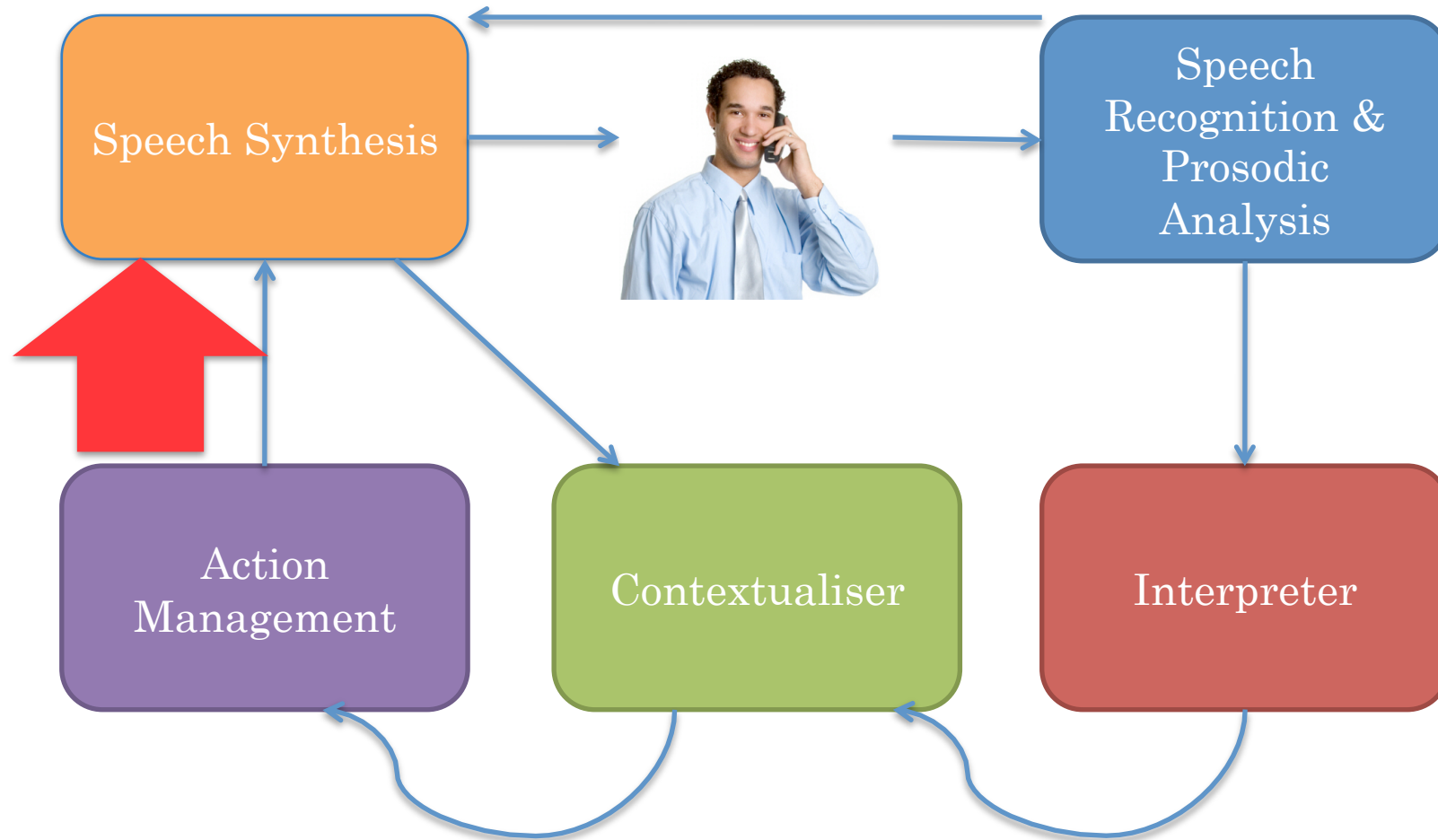
NUMBERS

ACTION MANAGEMENT



NUMBERS

SPEECH SYNTHESIS

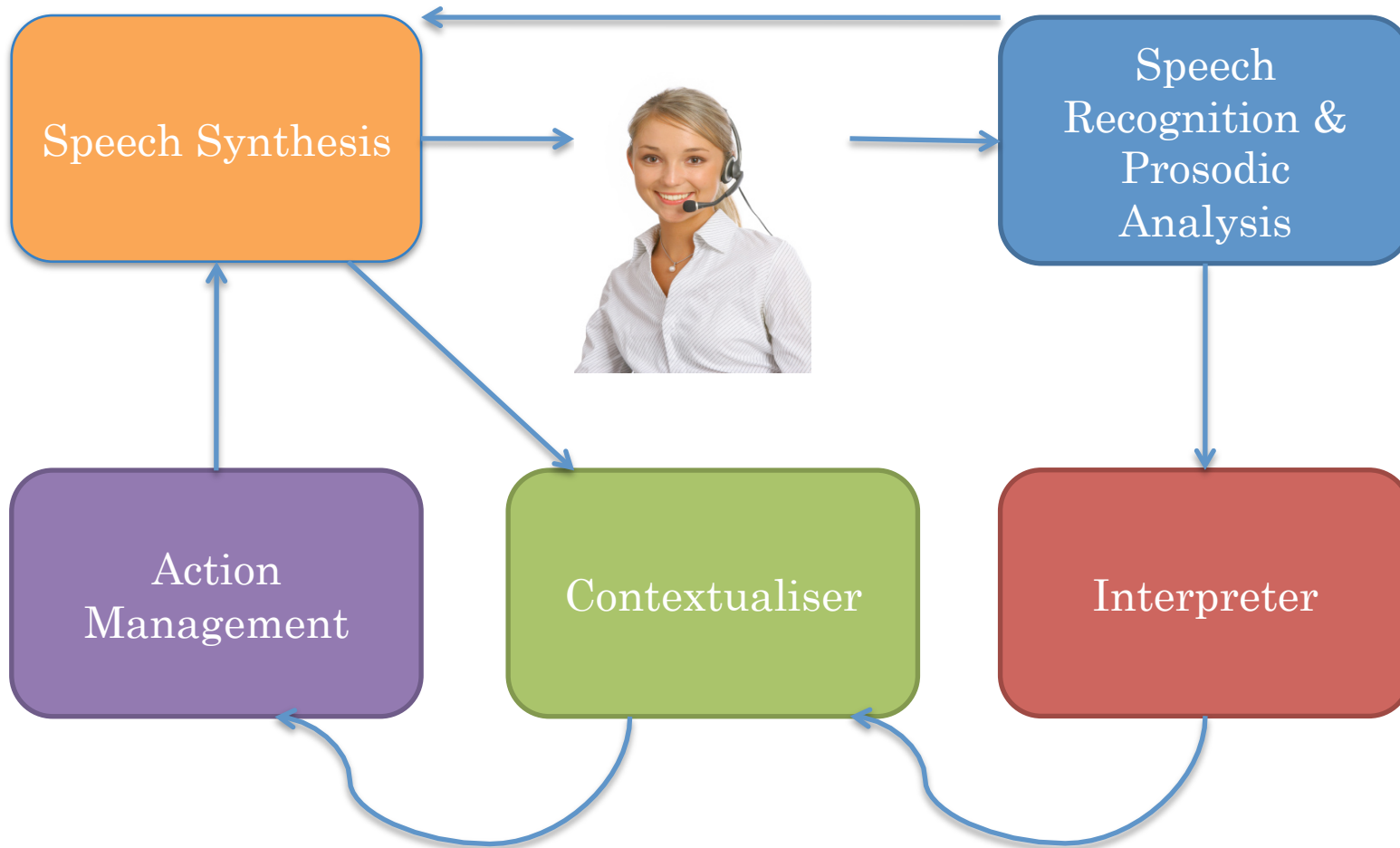


VISUAL DEMONSTRATION NUMBERS

Watch it at: http://www.youtube.com/user/gskantze?blend=4&ob=5#p/u/3/_rDkb1K1si8

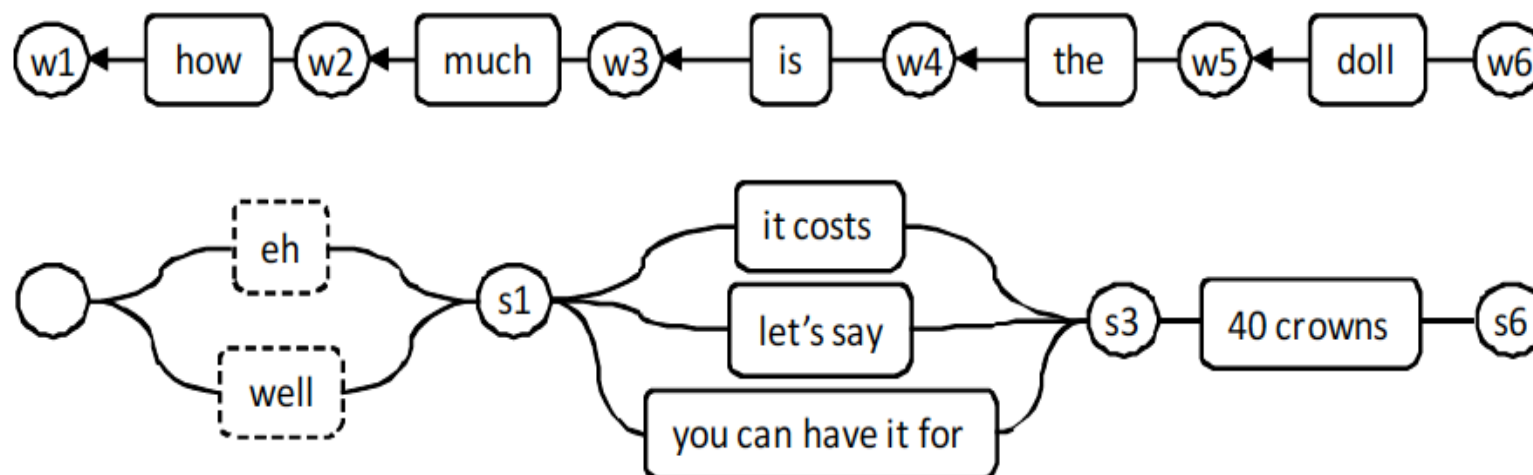
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JINDIGO



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INCREMENTAL SPEECHPLAN



SELF REPAIRS

covert segment repair	
overt segment repair	
covert unit repair	
overt unit repair	

AN EXAMPLE DIALOGUE BETWEEN A USER AND THE JINDIGO SYSTEM

S.1 **[welcome] [how may I help you]**

U.2 *I want to buy a doll*

S.3 **[eh] [here is] [a doll]**

U.4 *how much is it?*

S.5 **[eh] [it costs] [120 crowns]**

U.6 *that is too expensive how much is the teddy bear?*

S.7 **[well] [you can have it for] [let's see] [40 crowns]**

U.8 *I can give you 30 crowns*

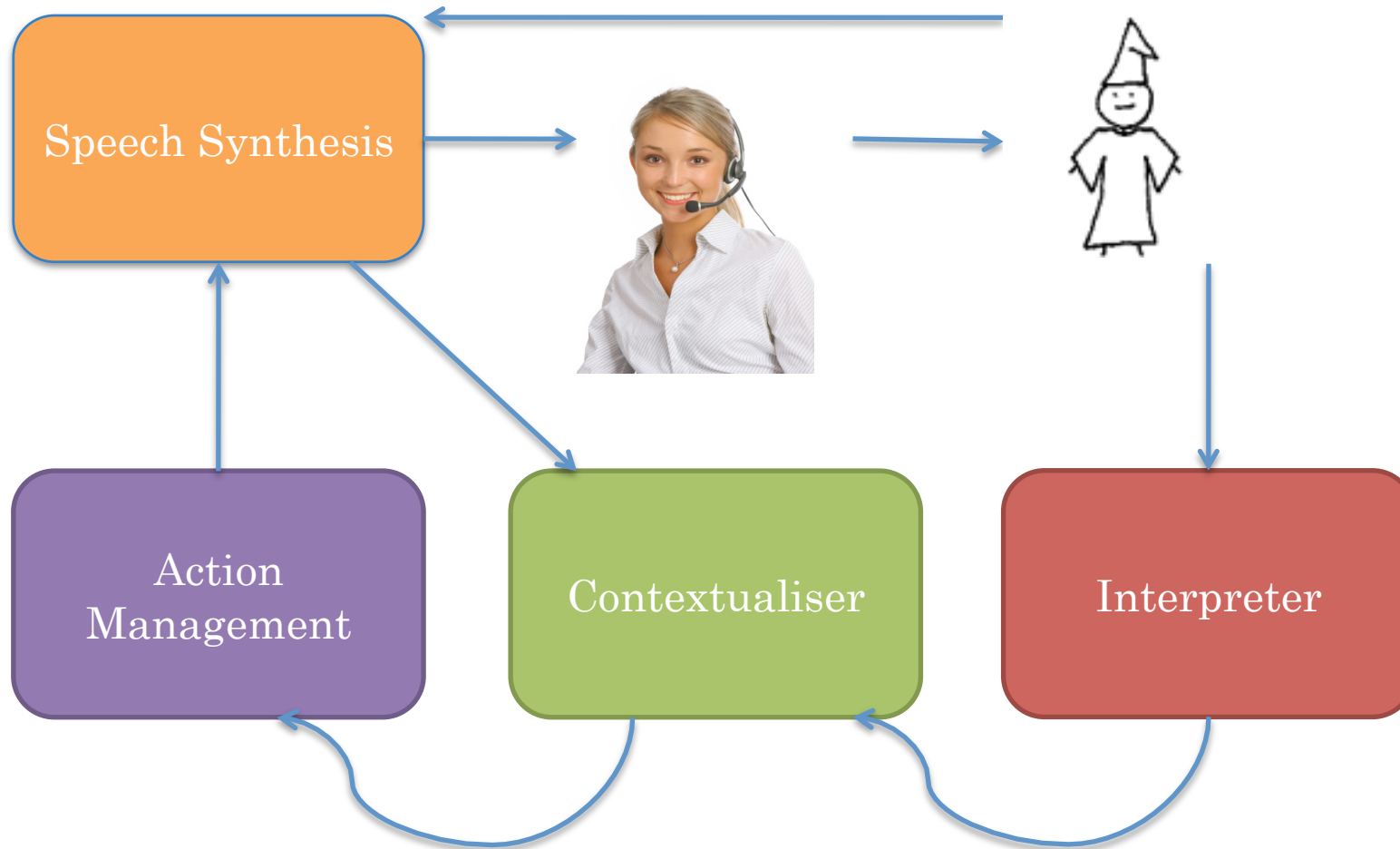
S.9 **[you could have it for] [37 crowns]**

U.10 *I can give you 10 crowns*

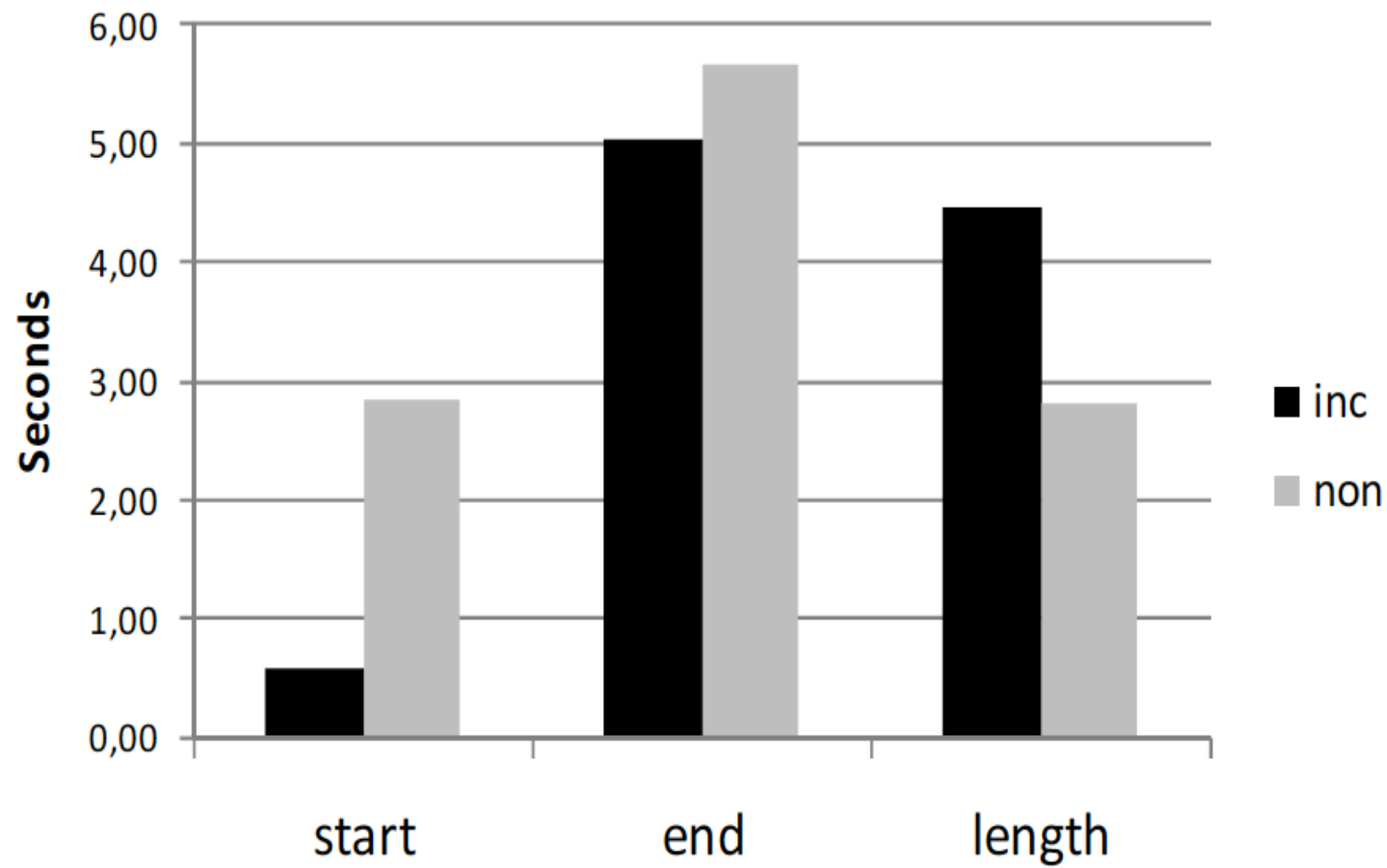
S.11 **[let's say] [or, I mean] [that is way too Little]**

Watch it at: <http://www.youtube.com/watch?v=cQQmgItIMvs>

A WIZARD-OF-OZ EXPERIMENT



RESPONSE TIME AND LENGTH



USER EXPERIENCE

	diff	z-value	p-value
preferred	0.23	-1.24	0.214
human-like	0.15	-0.76	0.445
polite	0.40	-2.19	0.028*
efficient	0.29	-2.08	0.038*
intelligent	0.11	-0.70	0.484
faster response	0.26	-1.66	0.097
feedback	0.08	-0.84	0.400
when to speak	0.35	-2.38	0.017*

WRAP UP

- Dialogue systems: Why? Which are out there?
What difference does incrementality make?
- Dialogue systems: Which topology, how does the information flow and how do the modules process information?
- Dialogue systems: Implementation examples.
How do they perform?

BIBLIOGRAPHY

- [Skantze, G., & Hjalmarsson, A. \(2010\)](#). Towards Incremental Speech Generation in Dialogue Systems. In Proceedings of SIGdial. Tokyo, Japan.
- [Skantze, G., & Schlangen, D. \(2009\)](#) Incremental dialogue processing in a micro-domain. In Proceedings of the 12th Conference of the European Chapter of the Association for Computational Linguistics (EACL-09). Athens, Greece.
- [Schlangen, D., & Skantze, G. \(2009\)](#) A general, abstract model of incremental dialogue processing. In Proceedings of the 12th Conference of the European Chapter of the Association for Computational Linguistics (EACL-09). Athens, Greece.
- <http://www.speech.kth.se/~gabriel/>