Improvised theatre with artificial intelligence

Piotr Mirowski
Albert & A.L.Ex
HumanMachine.live

London Creative AI Meetup
18 January 2017

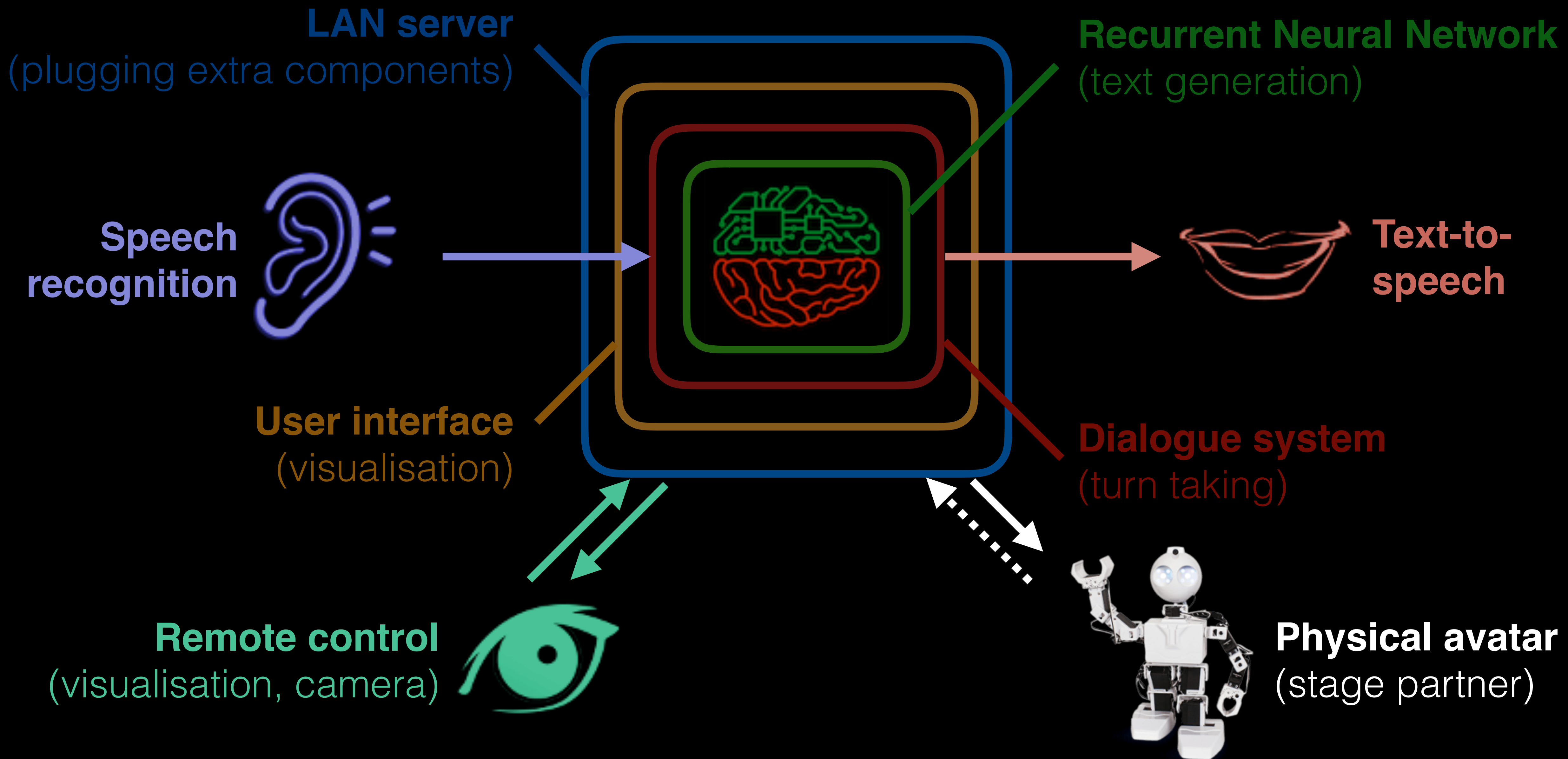# Language as sequences
"How did you come up with A.L.Ex?"

- Personal experience: learning English as a foreign language.
  Learn from **patterns of words** rather than from grammatical rules.

- **Statistical language models**:
  Learn to compute likelihood of a sentence, based on data.

- Improvised musical (Showstoppers, The Maydays):
  rhymes will come **naturally**… with some practice.

A.L.Ex*

*Artificial Language Experiment

LAN server
(plugging extra components)

Recurrent Neural Network
(text generation)

Speech recognition

Text-to-speech

User interface
(visualisation)

Dialogue system
(turn taking)

Remote control
(visualisation, camera)

Physical avatar
(stage partner)

Dataset

"Was A.L.Ex trained on movie lines?"

- OpenSubtitles
  http://www.opensubtitles.org
  http://opus.lingfil.uu.se/OpenSubtitles.php

- 100k movies (1902-2016)

- 880M word tokens

- Dataset used to train dialogue systems
  [Vinyals & Le (2015) "A Neural Conversational Model", *ICML Deep Learning Workshop*]

- Improv actors work from a huge selection of scripts
  [Martin, Harrison & Riedl (2016) "Improvisational Computational Storytelling in Open Worlds", *ICIDS*]

Statistical Language Models

- Claude Shannon's *N*-grams: $P(w_n \mid w_{n-1}, w_{n-2}, \ldots, w_1)$

- Example of n-gram generation from an improv textbook
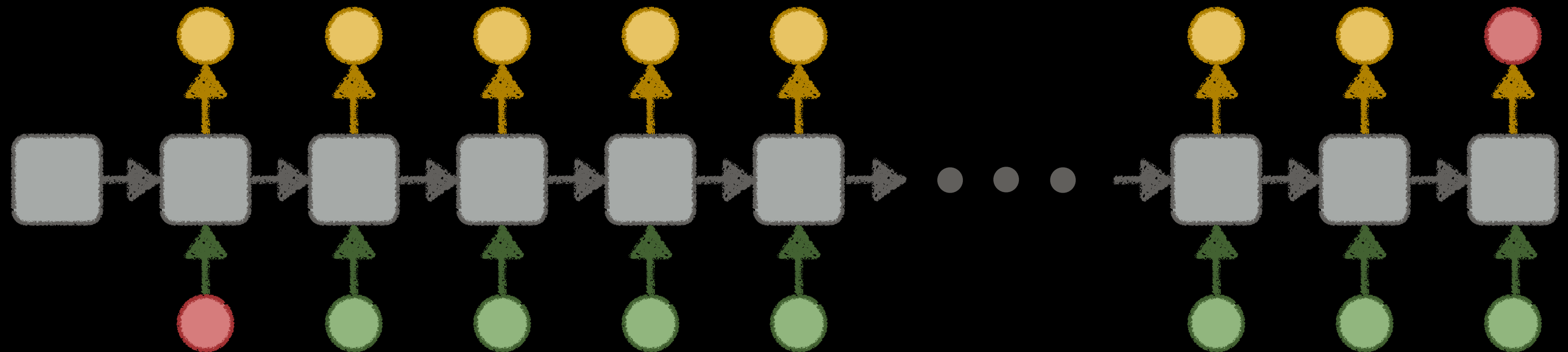 [Keith Johnstone (1979) "Impro: Improvisation and the theatre", *Faber and Faber*]
  dismissed as "not the sort of thing spewed out by the unconscious"
  ```
  "The head and frontal attack on an English writer
  that the character of this point is therefore
  another method for the letters that the time of
  whoever told the problem for an unexpected […]"
  ```

Recurrent Neural Networks
"How long is A.L.Ex's memory?"

"persistent memory":
state variable
for arbitrarily
long contexts

[Jeffrey L Elman (1991) "Distributed representations, simple recurrent networks and grammatical structure", *Machine Learning*;
Tomas Mikolov et al. (2010) "Recurrent neural network based language model", *INTERSPEECH*]

Long Short-Term Memory (LSTM)

[Sepp Hochreiter and Jürgen Schmidhuber (1997) "Long Short-Term Memory", *Neural Computation*; Alex Graves (2013) "Generating sequences with recurrent neural networks", *arXiv* 1308.0850]
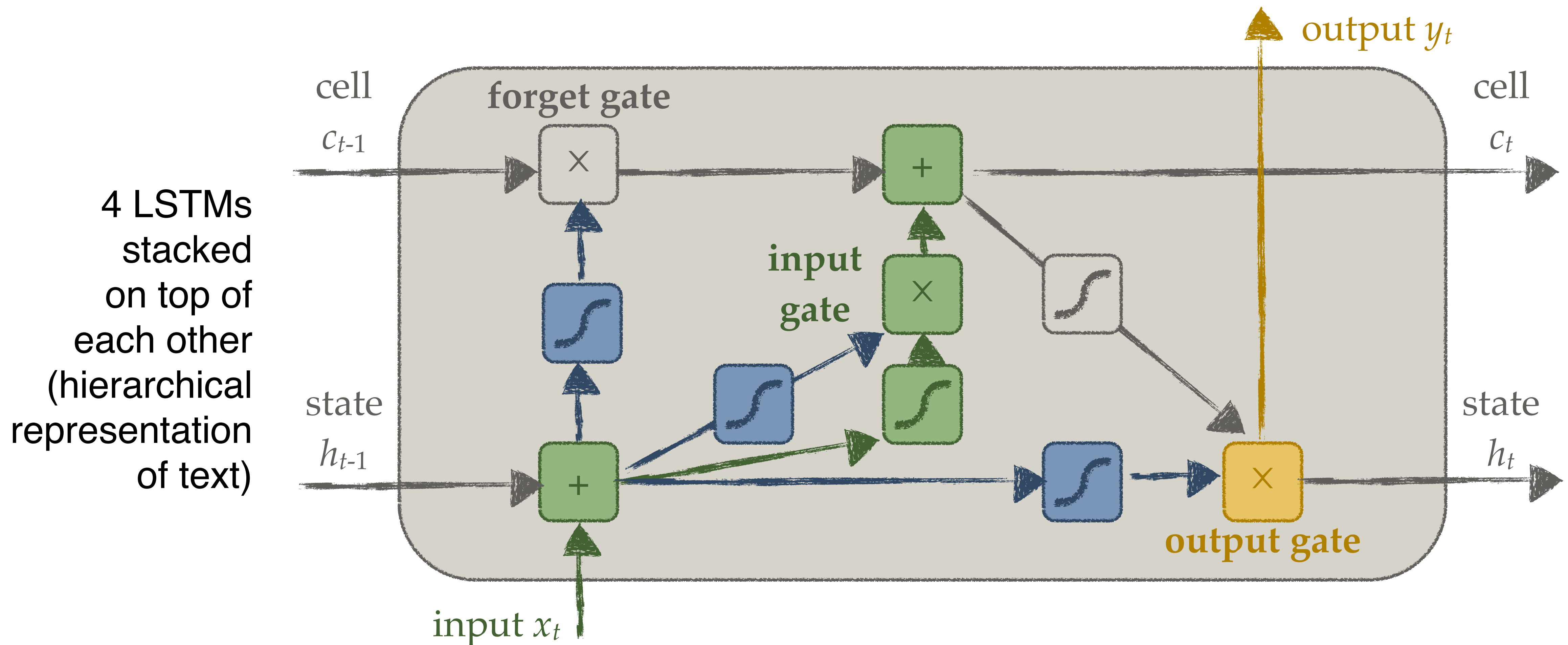
Topic models
"Can A.L.Ex stay on topic?"

- Latent Dirichlet Allocation (LDA) with 64 topics

- Computed per movie at training time

- Computed in real-time during improv

- Extra input to "stay on topic"

Topic 6:	Topic 21:	Topic 46:	Topic 62:
homicide	samurai	solar	vaccine
defendant	sensei	galaxy	tox
prosecutor	yakuza	nasa	hodgins
nypd	naruto	s.h.i.e.l.d.	e.r.
forensics	angelina	orbit	rayna
unsure	yoko	nadia	bp
callen	honda	galaxies	ct
weeks	shinichi	sonic	serum
dci	yamato	reactor	mri
ween	kato	asteroid	cdc
css	kimura	kraang	biopsy
chi	kyoto	activate	karev
annalise	yamamoto	satellites	surgeries
priors	shogun	tardis	abdominal
provenza	jutsu	spaceship	scalpel

[Mirowski et al. (2010) "Feature-Rich Continuous Language Models for Speech Recognition", *SLT*]

"Could A.L.Ex be rewarded for funny or successful scenes ?"

- Currently **word by word** text generation, **supervised training**

- Still thinking about proper way for **reinforcement learning…**

  - Reward structure: amount of laughs?

  - Improv and theatre in open-world setting are **more than a game**

- Reward dialogue system if it stays on track of an emotional trajectory?
  [Hernandez, Bulitko et al (2015) "Keeping the Player on an Emotional Trajectory in Interactive Storytelling", *AAAI*]

- Reward dialogue system for informative and coherent dialogue, train on self-play?
  [Li et al (2016) "Deep Reinforcement Learning for Dialogue Generation", *arXiv*]

ELIZA [Joseph Weizenbaum (1966)]

```
55    -- randomly selected replies if no keywords
56 ▼  local randReplies = {
57      "WHAT DOES THAT SUGGEST TO YOU?",
58      "I SEE...",
59      "I'M NOT SURE I UNDERSTAND YOU FULLY.",
60      "CAN YOU ELABORATE ON THAT?",
61      "THAT IS QUITE INTERESTING!",
62      "THAT'S SO... PLEASE CONTINUE...",
63      "I UNDERSTAND...",
64      "WELL, WELL... DO GO ON.",
65      "WHY ARE YOU SAYING THAT?",
66      "PLEASE EXPLAIN THE BACKGROUND TO THAT REMARK...",
67      "COULD YOU SAY THAT AGAIN, IN A DIFFERENT WAY?",
68    }
```

```
109     -- conjugate
110 ▼   local conjugate = {
111       [" I "] = "YOU",
112       [" ARE "] = "AM",
113       [" WERE "] = "WAS",
114       [" YOU "] = "ME",
115       [" YOUR "] = "MY",
116       [" I'VE "] = "YOU'VE",
117       [" I'M "] = "YOU'RE",
118       [" ME "] = "YOU",
119       [" AM I "] = "YOU ARE",
120       [" AM "] = "ARE",
121     }
```

```
70     -- keywords, replies
71 ▼   local replies = {
72       [" CAN YOU"] = "PERHAPS YOU WOULD LIKE TO BE ABLE TO",
73       [" DO YOU"] = "YES, I",
74       [" CAN I"] = "PERHAPS YOU DON'T WANT TO BE ABLE TO",
75       [" YOU ARE"] = "WHAT MAKES YOU THINK I AM",
76       [" YOU'RE"] = "WHAT IS YOUR REACTION TO ME BEING",
77       [" I DON'T"] = "WHY DON'T YOU",
78       [" I FEEL"] = "TELL ME MORE ABOUT FEELING",
79       [" WHY DON'T YOU"] = "WHY WOULD YOU WANT ME TO",
80       [" WHY CAN'T I"] = "WHAT MAKES YOU THINK YOU SHOULD BE ABLE TO",
81       [" ARE YOU"] = "WHY ARE YOU INTERESTED IN WHETHER OR NOT I AM",
82       [" I CAN'T"] = "HOW DO YOU KNOW YOU CAN'T",
83       [" SEX"] = "I FEEL YOU SHOULD DISCUSS THIS WITH A HUMAN.",
84       [" I AM"] = "HOW LONG HAVE YOU BEEN",
85       [" I'M"] = "WHY ARE YOU TELLING ME YOU'RE",
86       [" I WANT"] = "WHY DO YOU WANT",
87       [" WHAT"] = "WHAT DO YOU THINK?",
88       [" HOW"] = "WHAT ANSWER WOULD PLEASE YOU THE MOST?",
89       [" WHO"] = "HOW OFTEN DO YOU THINK OF SUCH QUESTIONS?",
90       [" WHERE"] = "WHY DID YOU THINK OF THAT?",
91       [" WHEN"] = "WHAT WOULD YOUR BEST FRIEND SAY TO THAT QUESTION?",
92       [" WHY"] = "WHAT IS IT THAT YOU REALLY WANT TO KNOW?",
93       [" PERHAPS"] = "YOU'RE NOT VERY FIRM ON THAT!",
94       [" DRINK"] = "MODERATION IN ALL THINGS SHOULD BE THE RULE.",
95       [" SORRY"] = "WHY ARE YOU APOLOGIZING?",
96       [" DREAMS"] = "WHY DID YOU BRING UP THE SUBJECT OF DREAMS?",
97       [" I LIKE"] = "IS IT GOOD THAT YOU LIKE",
98       [" MAYBE"] = "AREN'T YOU BEING A BIT TENTATIVE?",
99       [" NO"] = "WHY ARE YOU BEING NEGATIVE?",
100      [" YOUR"] = "WHY ARE YOU CONCERNED ABOUT MY",
101      [" ALWAYS"] = "CAN YOU THINK OF A SPECIFIC EXAMPLE?",
102      [" THINK"] = "DO YOU DOUBT",
103      [" YES"] = "YOU SEEM QUITE CERTAIN. WHY IS THIS SO?",
104      [" FRIEND"] = "WHY DO YOU BRING UP THE SUBJECT OF FRIENDS?",
105      [" COMPUTER"] = "WHY DO YOU MENTION COMPUTERS?",
106      [" AM I"] = "YOU ARE",
107    }
```

Physical avatar
"Could you have a robot on stage?"

- Educational robot [www.ez-robot.com]
  with C# Software Development Kit

- 16 servos, control angles

- Two 3x3 LED grids, control colour

- Camera: add face tracking (OpenCV)

[Image credit: www.ez-robot.com]

A fun, personal, DIY project

- Not a research project - but relying on (relatively) state-of-the-art research

- Coded in Lua / Torch, Python, C# and Javascript

- Recurrent Neural Language Model: **Torch RNN**
  github.com/jcjohnson/torch-rnn

- Topic Model: **Vowpal Wabbit**
  https://github.com/JohnLangford/vowpal_wabbit

- EZ-Robot JD Humanoid, EZ-SDK Mono
  https://www.ez-robot.com/

- Trained on a GPU in the cloud

Kory Mathewson

April 2016, Pyggy

http://korymathewson.com/building-an-artificial-improvisor/

RNNs in theatre and cinema

"Beyond the Fence" (2016)

Benjamin Till, Nathan Taylor

Photograph: Tristram Kenton for the Guardian

"Sunspring" (2016)

Ross Goodwin (rossgoodwin.com), Oscar Sharp

[http://arstechnica.com/the-multiverse/2016/06/an-ai-wrote-this-movie-and-its-strangely-moving/]

A computer stage partner

[Image credits: Kory Mathewson,
http://korymathewson.com/building-an-artificial-improvisor/]

- Improv lessons from playing with an AI

- Humility lesson from improv and theatre

Improv is about doing the *obvious* thing

- Surprisingly hard…

  - Trying to be "funny" or "interesting" makes improv boring.

  - Need to overcome social fears.

- "I began to think of children not as immature adults,
  but of adults as atrophied children."
  [Keith Johnstone (1979) "Impro: Improvisation and the theatre", *Faber and Faber*]

- "Know that you knew how to do this when you were six years old,
  other stuff just got in the way."
  [Jill Bernard (2002) "Small Cute Book of Improv", *YESand.com*]

Search query auto-completion and listening skills in improv

i ○
instagram itv player indeed iplayer

imp ○
impossible quizz impetigo imperial war museum imperial college london

improv ○
improv games improv classes london improv everywhere improv comedy

- Simply suggest the most **obvious** (relevant) query given the **context**:
  query prefix, location, time of day, day of year, previous searches…

- Improvisers: **listen** to *cues* to extend the context!
  (explicit) characters, story, reincorporation of past facts…
  (implicit) body language, theory of mind…

A.L.Ex: an exercise in justification

- When the machine gives difficult suggestions…

- Justification game: "real-time dynamic problem solving".
  Improvisers need to (observe, repair, accept) divergences.
  [Magerko et al (2009) "An Empirical Study of Cognition and Theatrical Improvisation", *C&C*]

- Being able to improvise with anybody:
  e.g., Kory would improvise with a non-improviser audience member.

- Make the stage partner look good!

Fortunate failures

- With tech on stage, preparation is key…

- Make contingency plans!

- But one should embrace failure.

- 21 September 2016, at the Miller Pub: had to restart A.L.Ex on stage…

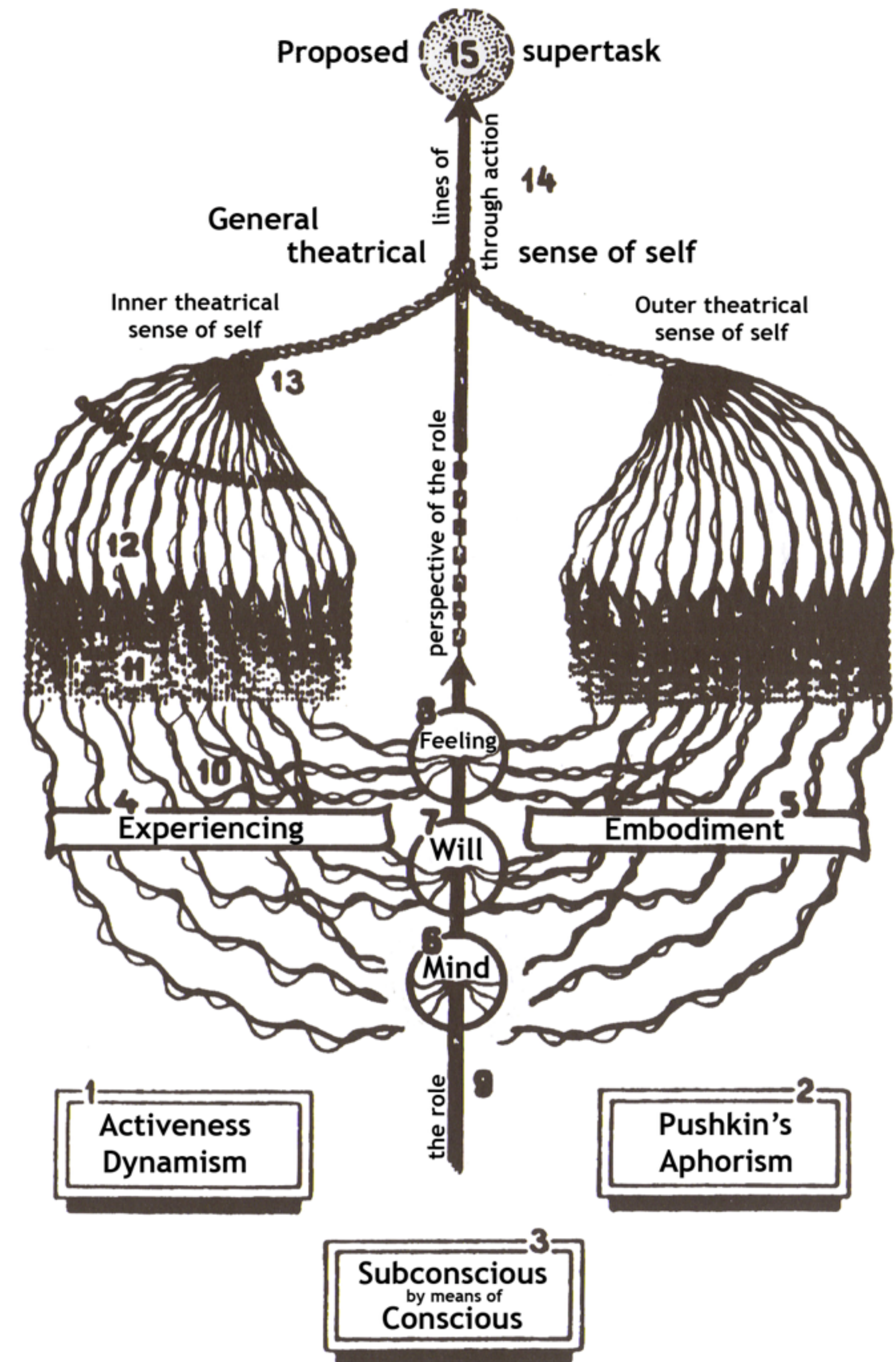 - Decided to show code in next shows.

- Get inspired by failures.

Konstantin Stanislavski (1863-1938) and the actor's *System*

Stanislavski (far left) in The Lower Depths
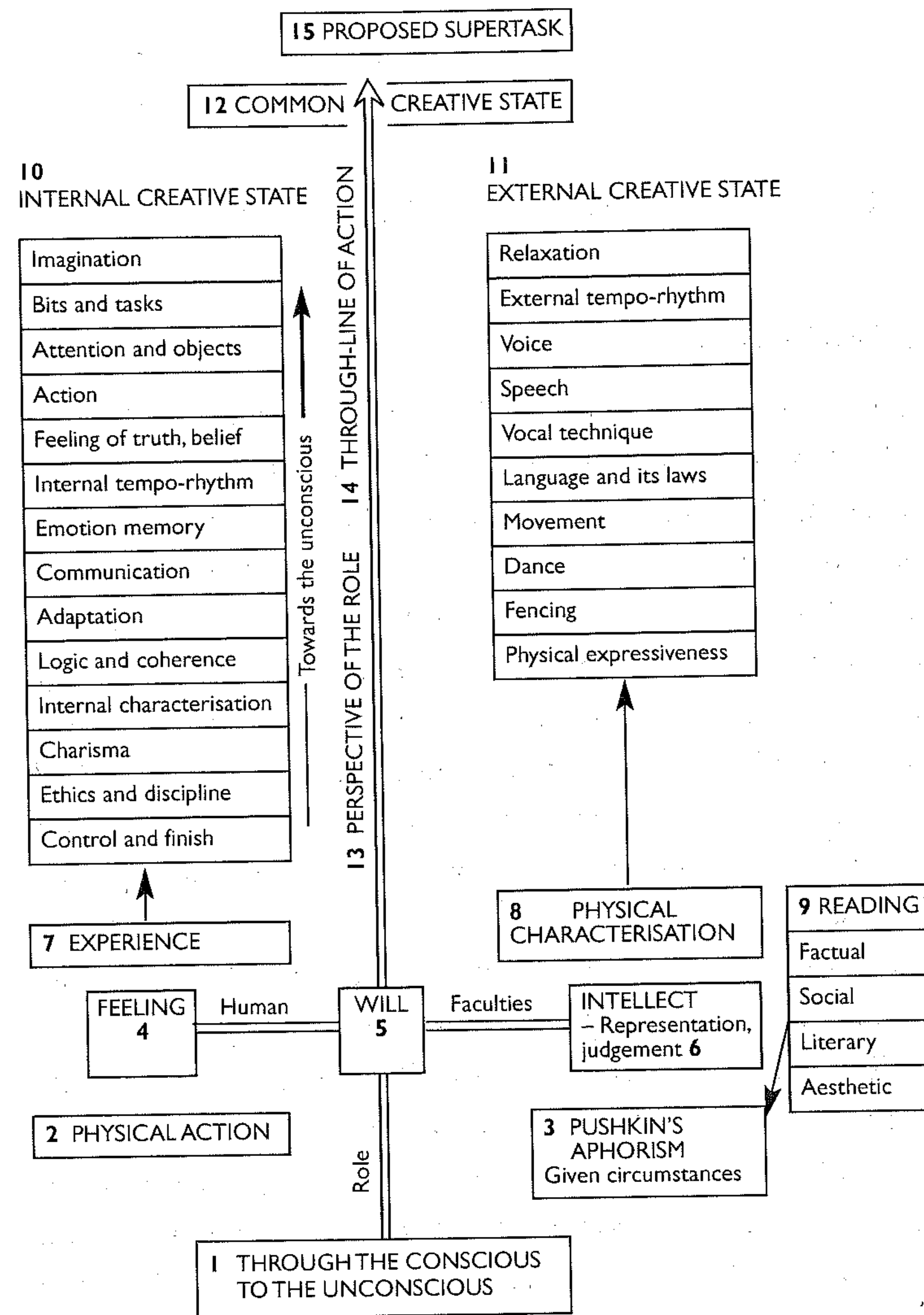at The Moscow Art Theatre,1902

Aim towards **super-objective** of the character and of the play

Create a "third being" character creation as self-transformation

Draw on memory and experience to give **emotional depth** to play

Each line of the script is **actioned**, actor "does" something to others (how to get what one wants)

Determine the **units** of the script with their own **objectives** (what the character wants)

Practice physical characterisations of the character to acquire reflexes (e.g., **animal work**)

Rely on intellect to understand the character

Research the **context** of the play and of its characters: original text, facts, social conventions…

Determine **Given Circumstances**: Where, when, who, what, why, obstacle, how (to overcome obstacle)

15 PROPOSED SUPERTASK

12 COMMON CREATIVE STATE

10 INTERNAL CREATIVE STATE

Imagination
Bits and tasks
Attention and objects
Action
Feeling of truth, belief
Internal tempo-rhythm
Emotion memory
Communication
Adaptation
Logic and coherence
Internal characterisation
Charisma
Ethics and discipline
Control and finish

11 EXTERNAL CREATIVE STATE

Relaxation
External tempo-rhythm
Voice
Speech
Vocal technique
Language and its laws
Movement
Dance
Fencing
Physical expressiveness

13 PERSPECTIVE OF THE ROLE
14 THROUGH-LINE OF ACTION
Towards the unconscious

7 EXPERIENCE

8 PHYSICAL CHARACTERISATION

9 READING
Factual
Social
Literary
Aesthetic

FEELING 4 — Human — WILL 5 — Faculties — INTELLECT – Representation, judgement 6

2 PHYSICAL ACTION

Role

3 PUSHKIN'S APHORISM
Given circumstances

1 THROUGH THE CONSCIOUS TO THE UNCONSCIOUS

[Credit: Jean Benedetti (2008) "Stanislavski: An Introduction", *Bloomsbury*]

A lesson in humility from theatre

[Image credit: www.pixar.com]

- Creating an AS (Artificial Stanislavski) actor is AI-hard…

- … and somewhat pointless:

  - Audience can suspend disbelief and anthropomorphise robots.

  - What is interesting in theatre or improv is how the human actor overcomes adversity.

Thank you!

https://humanmachine.live

And many thanks to:
Kory Mathewson,
Alessia Pannese,
Stuart Moses,
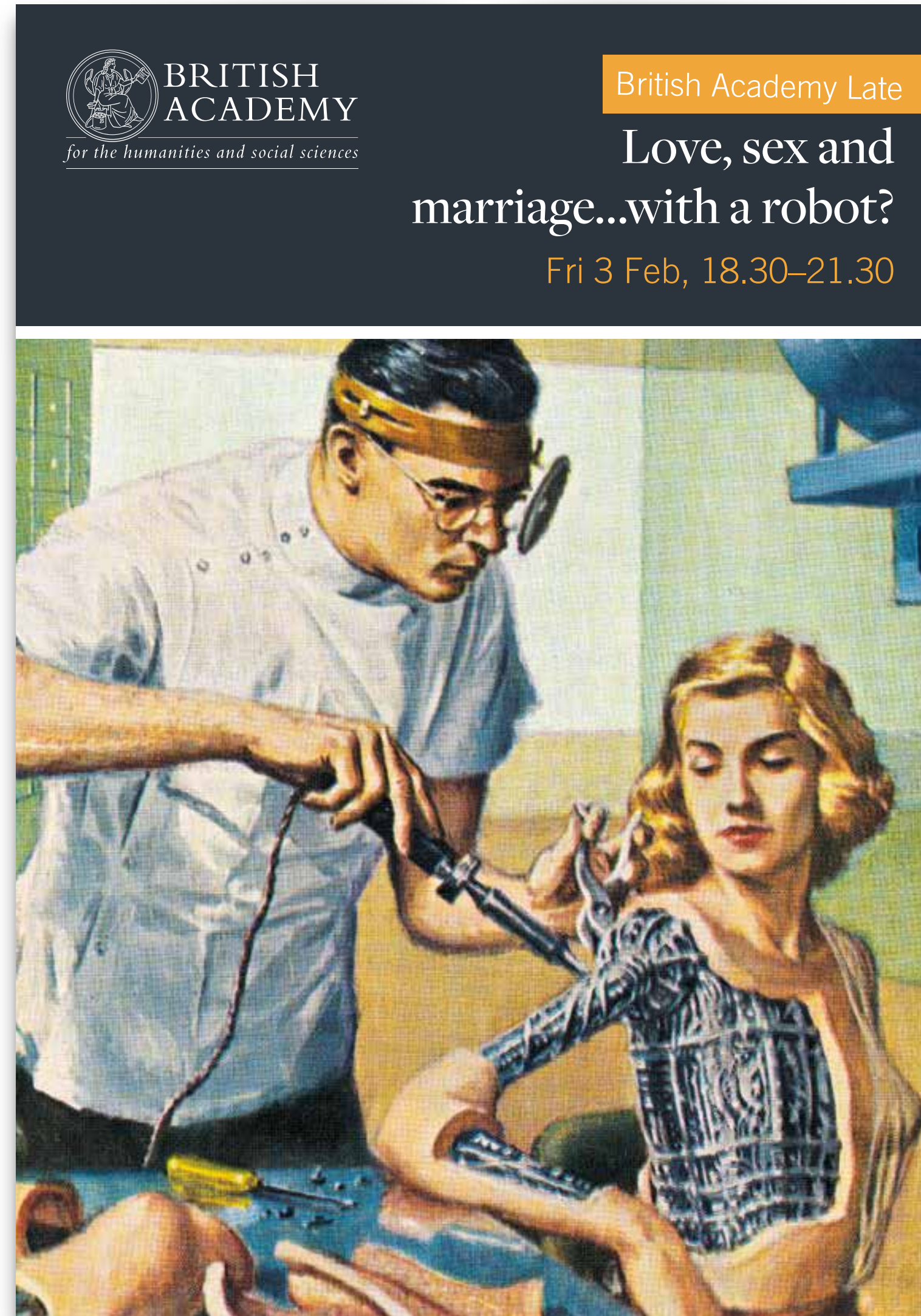Roisin Rae,
John Agapiou,
Katy Schutte,
Benoist Brucker,
Stephen Davidson,
Luba Elliot,
Shama Rahman,
Steve Roe,
Michael Littman…

BRITISH ACADEMY
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Love, sex and marriage...with a robot?

Fri 3 Feb, 18.30–21.30

IMPRO FEST UK

31 March, 1 April 2017