



# USC Institute for Creative Technologies

University of Southern California

## **FLoReS** **A Forward Looking Reward Seeking Dialogue Manager**

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# Goals: Wide Applicability, Be able to Support:

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- Multiple Interaction types
  - User Initiative
  - System Initiative
  - Mixed Initiative
- Multiple Interaction Modalities
  - Output:
    - Virtual human (speech and non-verbal), game engine
    - Virtual human, web delivery
    - Text chat
  - Input
    - Typed text
    - Menus
    - Speech & vision
- Multiple Author types
  - Knowledge, domain experts
  - Creative writers
  - Dialogue system experts
- Multiple Authoring methods
  - GUIs
  - expert mode (programming)
- Multiple Control mechanisms
  - Call-flow graphs
  - Reactive rules
  - Information-state inference
  - Planning operators (pre-conditions/effects)
  - Reward maximization





# FLoReS – building blocks

- Information state
  - Interface to NLU & NLG is dialogue acts (could be label or feature structure)
  - Propositional KB
- Forward inference rules
  - To store entailment relations
  - If-then-else
    - E.g.: **having nightmares implies having sleeping problems**
- Event handlers (aka information state update rules)
  - To represent operator-independent information-state updates
  - If-event-then
    - E.g.: **if user said “I’ve nightmares” set the nightmare variable to true**
- Operators
  - reusable sub-dialogue structures
  - Pre-conditions, effects
  - Qualitative goals, assigned numeric values (that could be changed in rules)
- Selection of next operator to maximize the expected reward





# Dialogue Systems Using FLoReS

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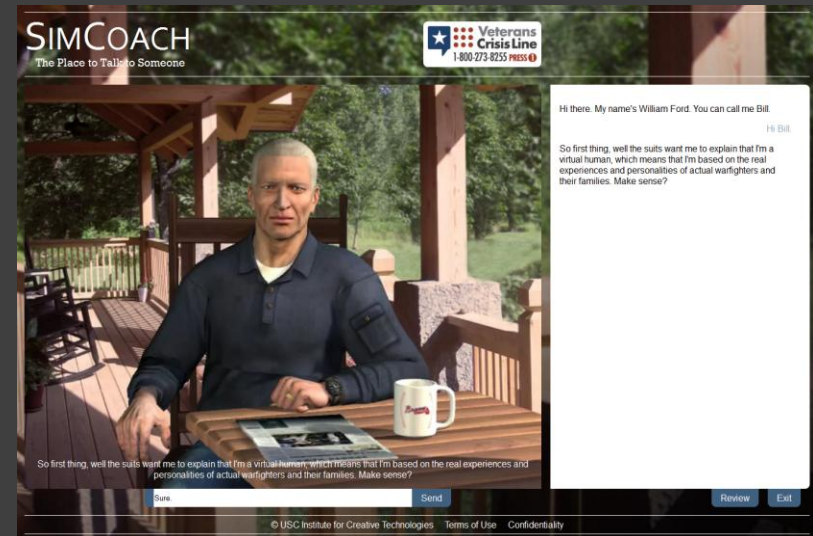
- SimCoach: web-delivered virtual human, text and menu input
- Braveheart: <http://www.braveheartveterans.org/>
- DCAPS SimSensei – multimodal sensing (speech, vision)
- ProQOL- wellness of care providers
- Cultural-differences in negotiation (web character for playing economic games and values survey)





# FLoReS – example (from the SimCoach character)

- Chat based web character
- Goal: to encourage seeking help to address psychological problems caused by deployment
- 285 operators
  - 150 automatically generated (simple QA template)
- 3 months – 2 people





# FLoReS – example (from the SimCoach character)

*Greeting and introduction*  
...what do you think?

User says: **I'm always tired**

- When input information reaches the DM it's used to update the information state (event handlers, forward IRs)
- Then the dialog manager can:
  - Say nothing
  - Ignore the user and say something else
  - Respond to the user input
- The decision is based on the reward associated to each operator



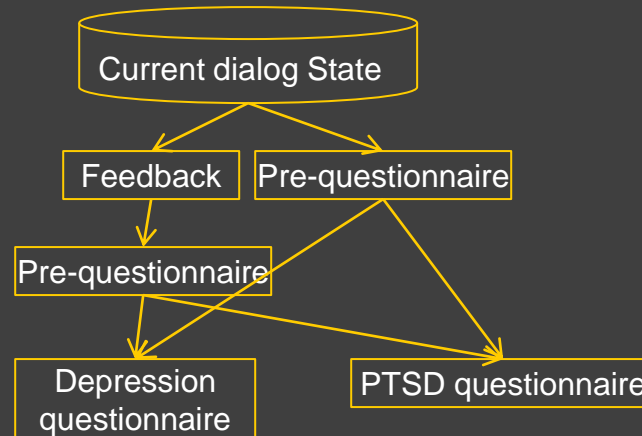


# FLoReS – example

*Greeting and introduction*  
...what do you think?

User says: **I'm always tired**

- The dialog manager builds a forecast of possible future conversations



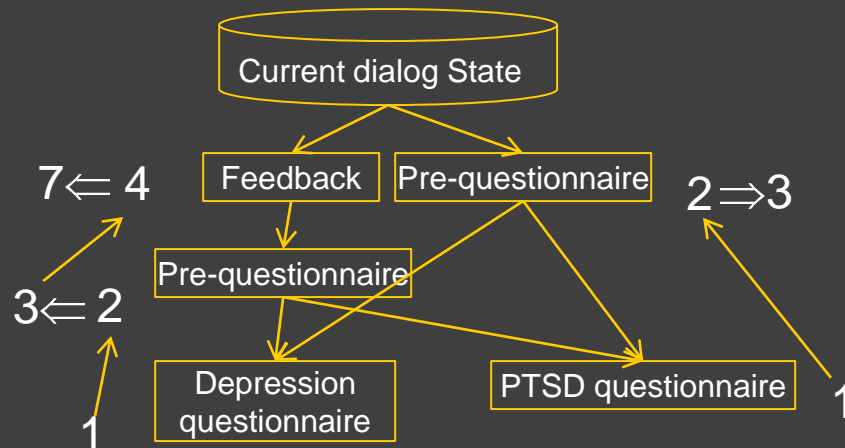


# FLoReS – example

*Greeting and introduction*  
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User says: I'm always tired

- Then the rewards are propagated back to the initial state



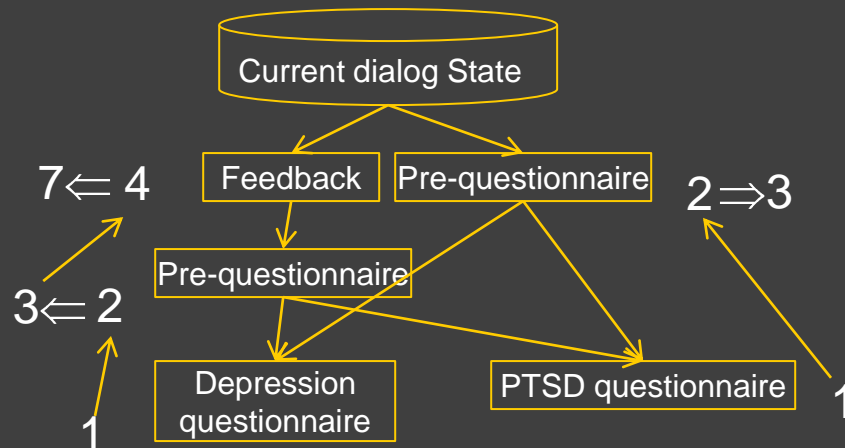


# FLoReS – example

*Greeting and introduction*  
...what do you think?

User says: I'm always tired

- The operator with the highest reward is selected





# FLoReS – example

*Greeting and introduction*  
...what do you think?

User says: **I'm always tired**

*Feedback*  
That's real tough, I'm sorry to hear that

*Pre-questionnaire*  
Can you tell me more about that?

*Re-sentence option*  
Back to it, then.

User says: **Sure**

*Wait for anything from the user*

Alright, let's explore that a bit. I hope you don't mind, but I'm gonna have to ask you some questions to get to know you better.  
First off, has your sleeping been troubled lately?

Yes

No

Have you been having any nightmares?

Excellent. A good night's rest can make all the difference in the world



■ A sub-dialogue can be a complex set of actions

- Should represent a reusable portion of a dialogue
- It's a tree (no cycles)





# FLoReS – example

*Greeting and introduction*  
...what do you think?

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*Re-entrance option:*  
Back to it, then.

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*Feedback*

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*Pre-questionnaire*

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User says: **Sure**

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First off, has your sleeping been troubled lately?

User says: **Wait, is this place confidential?**

Have you been having any nightmares?

Excellent. A good night's rest can make all the difference in the world



- The user said something unexpected
- Run forward search to select the best operator





# FLoReS – example

*Greeting and introduction*  
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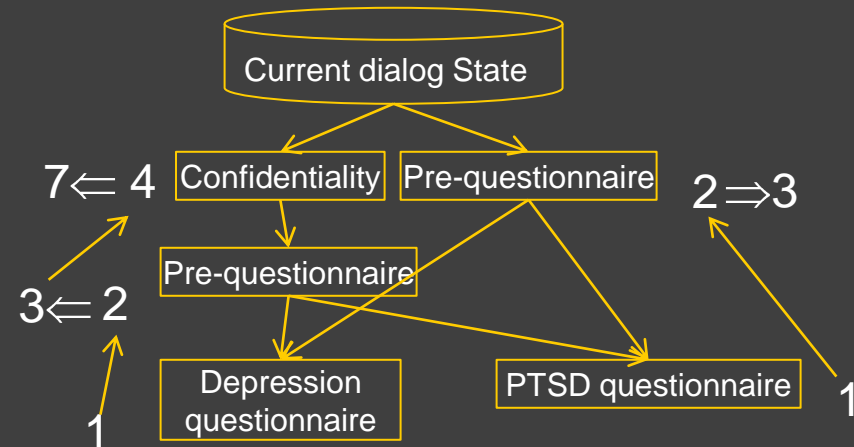
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# FLoReS – example

## Feedback

That's real tough, I'm sorry to hear that

## Pre-questionnaire

Can you tell me more about that?

*Re-entrance option:*

Back to it, then.

User says: **Sure**

Alright, let's explore that a bit. I hope you don't mind, but I'm gonna have to ask you some questions to get to know you better.

First off, has your sleeping been troubled lately?

User says: Wait, is this place confidential?

## Confidentiality

All your information will be kept extremely confidential. I'm not interested in your name, just in how I can help.

Did that answer your question?

User says: **Yes**

Great

*No*

Your privacy and the confidentiality of your conversations are very important to us. We've taken...

- The current operator terminates
- Run forward search to select the best operator





# FLoReS – example

## Feedback

That's real tough, I'm sorry to hear that

## Pre-questionnaire

Can you tell me more about that?

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User says: **Sure**

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Re-entrance option:  
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# Text authoring

```
Network deployed{
  #topic: qa.deployed
  #entrance condition: system initiative
  #condition: !known(deployed)

  {
    system: question.bio-info.been-
      deployed
    {
      user: OR(answer.bio-info.deployed.
        yes,yes-answer)
      #information state: deployed = true
    }
    OR
    {
      user: OR(answer.dont-know,no-answer)
      #information state: deployed = false
    }
  }

  #goal: ask-user-for-personal-info
}
```

# Roundtable Web authoring UI



Roundtable Authoring  
Subdialog Editor  
Revision: 10537

About ICT [project]  
ICT - Prototypes - SimCoach [subdialog]  
2012 Jun 14 12:54:51 by kelly [created]  
2012 Jun 30 15:59:40 by kelly [modified]

← Interactions

✓ Save

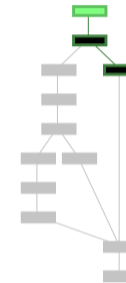
Entrance Conditions[1]:

Initiative	Event	Condition
User	question.sim coach	

Edit

Reentry

☐ No Reentry Allowed



Add System Action

Add User Action

New Action from Template...

Merge

Preview

Action From: System

Delete Action

☐ Reentry prevented after this action

Speech Act:

ict.prototypes.simcoach.video

Action Type:

Utterance

Create

Sample Text:

SimCoach Video

Notes:

Condition:

Add Condition

Goals:

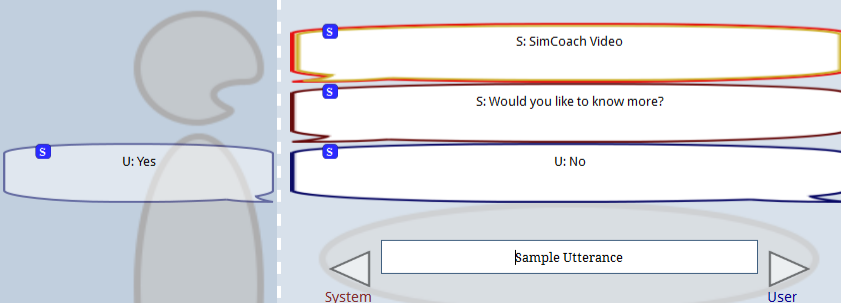
Add Goal

Variable Updates:

Add Update

Resume Option:

Add Resume Option





# Future Work

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- Systematic Evaluation
  - Systems using FLoReS
  - Authorability
  - Efficacy of different control mechanisms
    - Best practice
- Better ontology support (automated dialogue acts and sub-dialogue creation)
- Fuse data-driven and hand-authoring policy
  - RL & user simulation for reward maximization
  - Inverse reinforcement learning to learn or adjust rewards
    - Learn to weight differently the possible paths in the predefined call-flow graph of each operator





# Conclusion

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- Flores supports flexible mixed initiative and authoring by domain experts
  - Hybrid approach to control
  - Support for authoring
- soon to be released in the ICT VHToolkit:  
<https://confluence.ict.usc.edu/display/VHTK/Home>





# Questions?

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