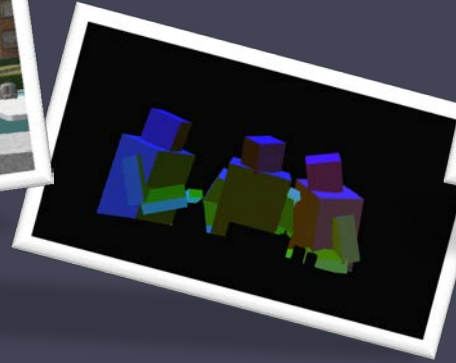




Twenty-Ninth AAAI Conference
2015

Continuity Editing for 3D Animation



Inria

UMR IRISA



LABORATOIRE
JEAN KUNTZMANN
MATHÉMATIQUES APPLIQUÉES - INFORMATIQUE

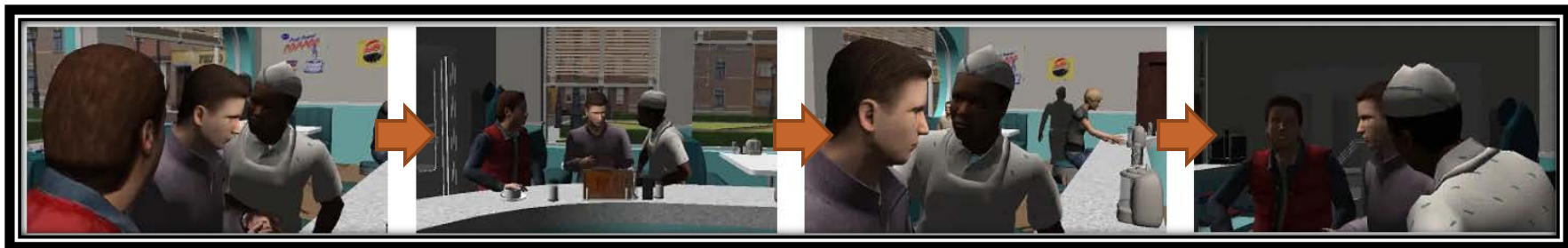
UNIVERSITÉ DE
RENNES 1

Quentin Galvane
Rémi Ronfard
Christophe Lino
Marc Christie

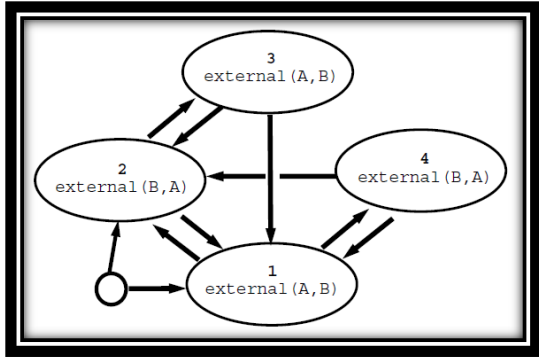
- **Grand Challenge: Automated film-making**
(Mark Riedl AAAI – WICED 2014)
- **Specialized agents with cinematographic knowledge**
 - **Director, actor, cameraman, film-editor**
- **With applications to games**



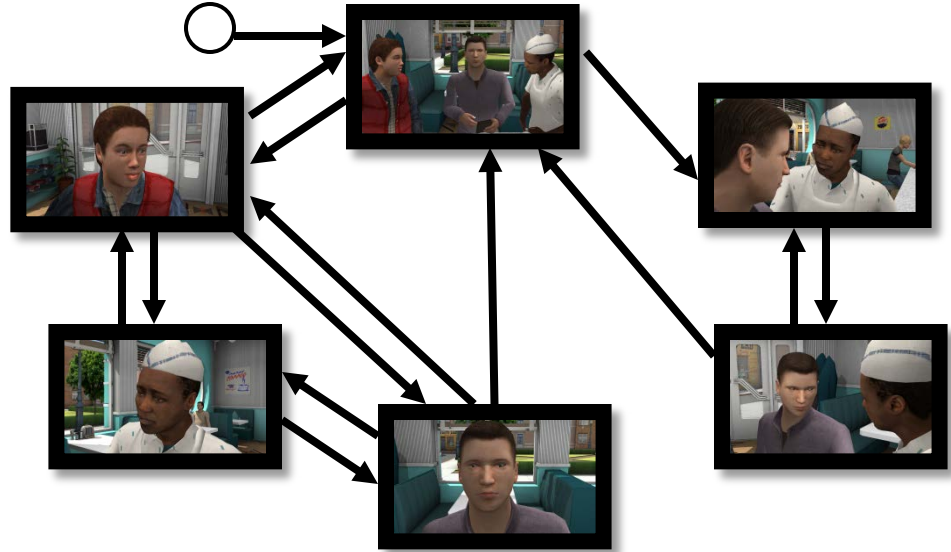
- Read actions and dialogues from script
- Generate 3D animation
- Place cameras and lights, generate rushes
- Edit the rushes into a movie



Idiom based solutions

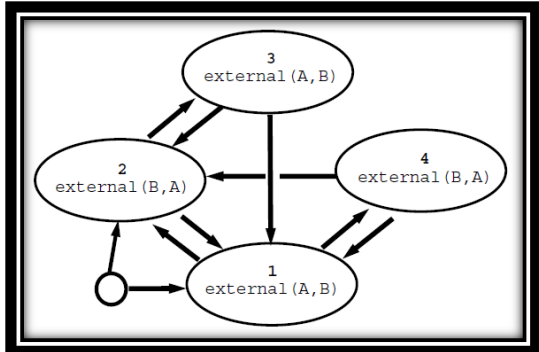


Virtual cinematographer
[Christianson et al. 1996]

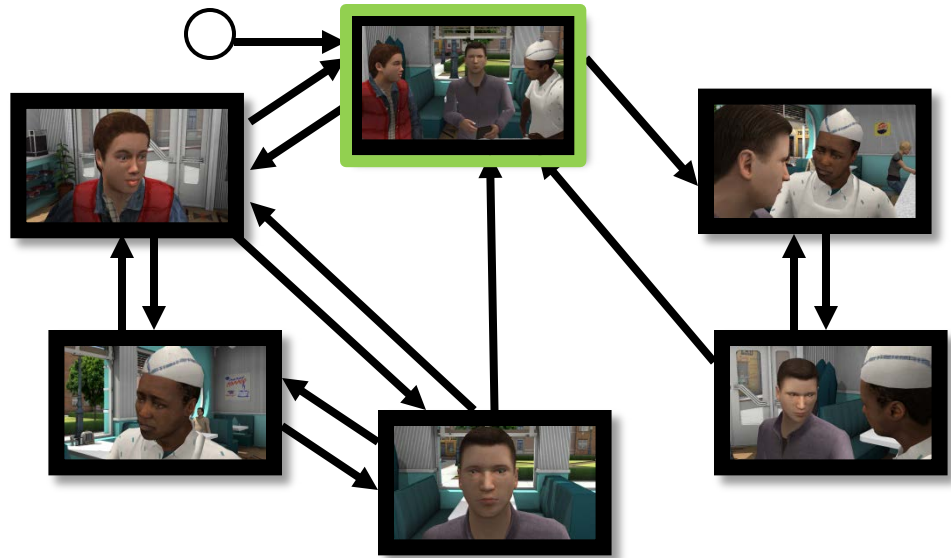


Scenario

Idiom based solutions

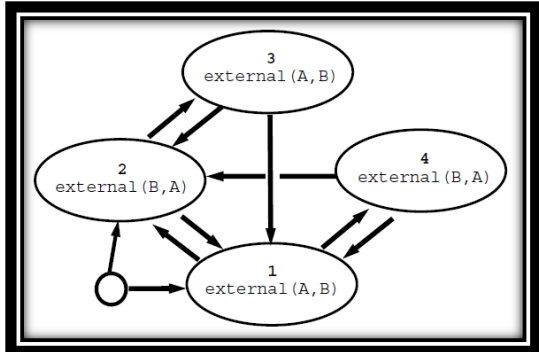


Virtual cinematographer
[Christianson et al. 1996]

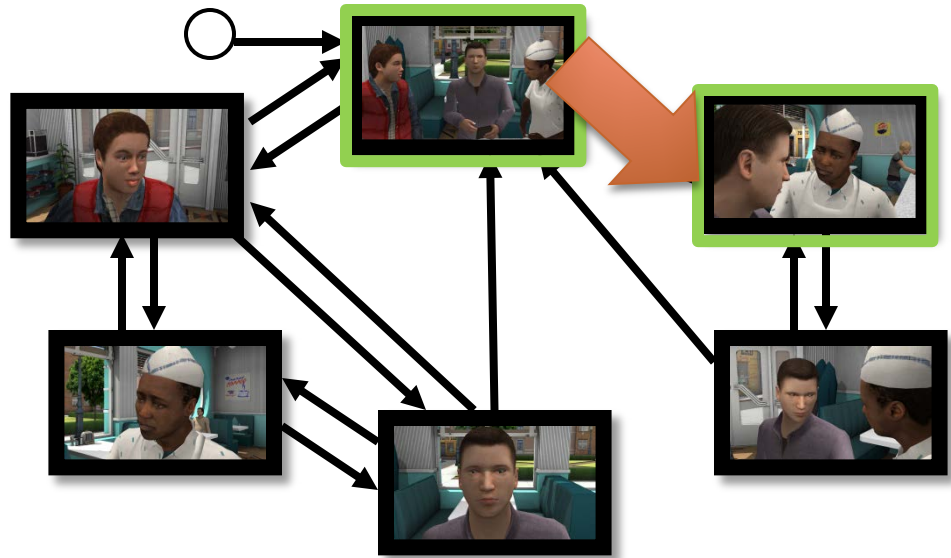


Scenario

Idiom based solutions

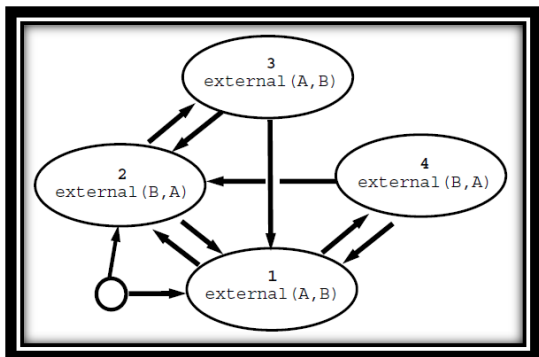


Virtual cinematographer
[Christianson et al. 1996]

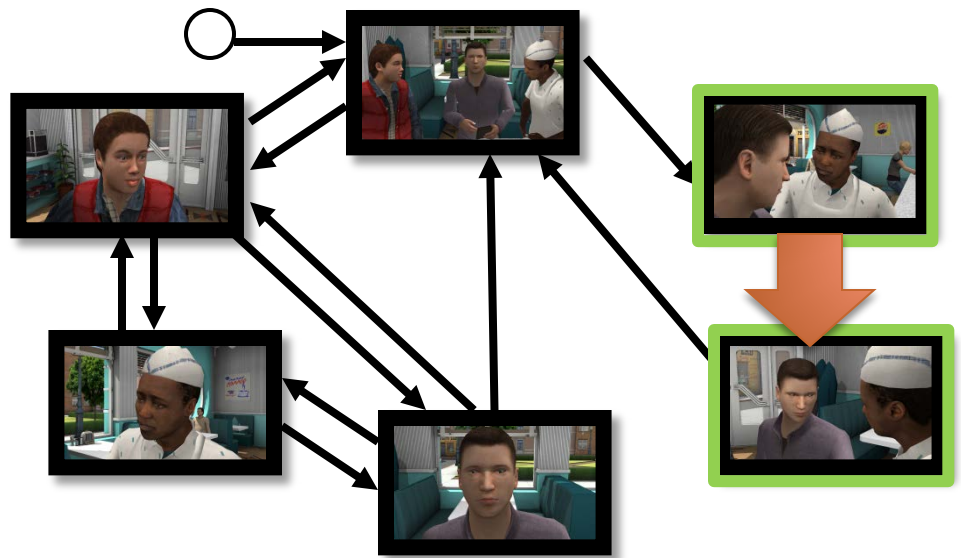


Scenario

Idiom based solutions

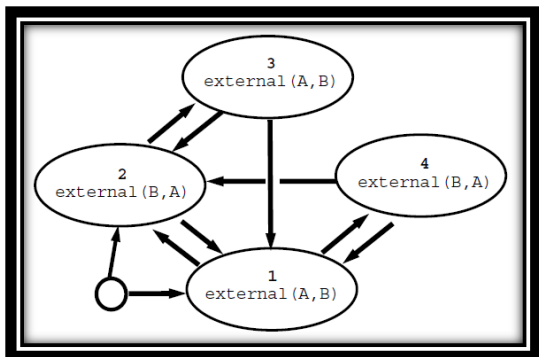


Virtual cinematographer
[Christianson et al. 1996]

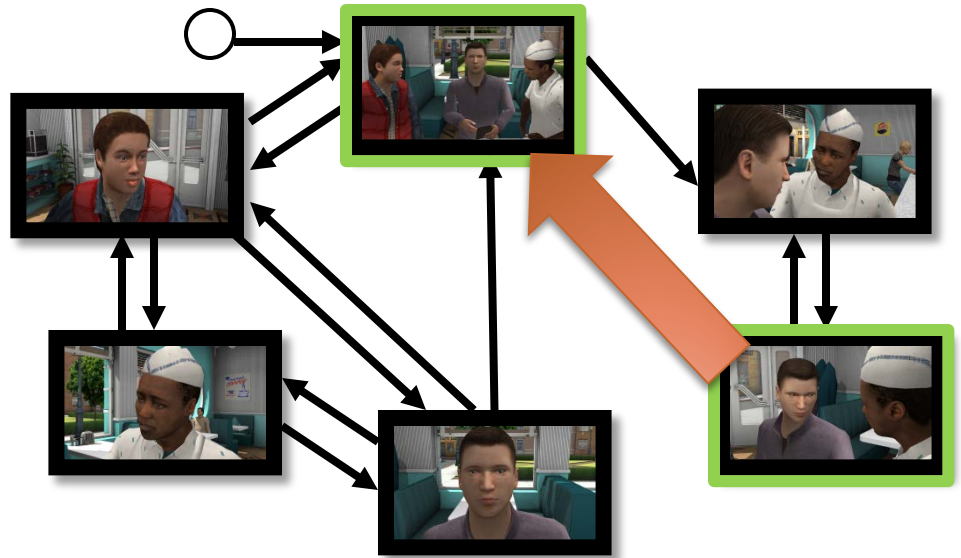


Scenario

Idiom based solutions

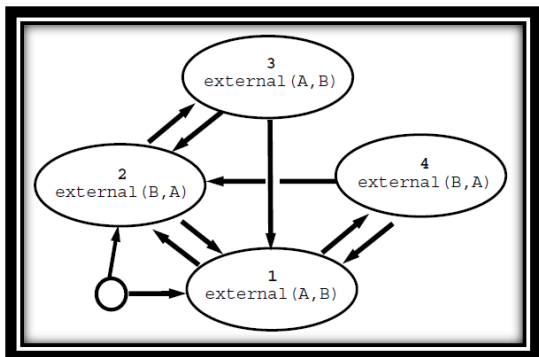


Virtual cinematographer
[Christianson et al. 1996]

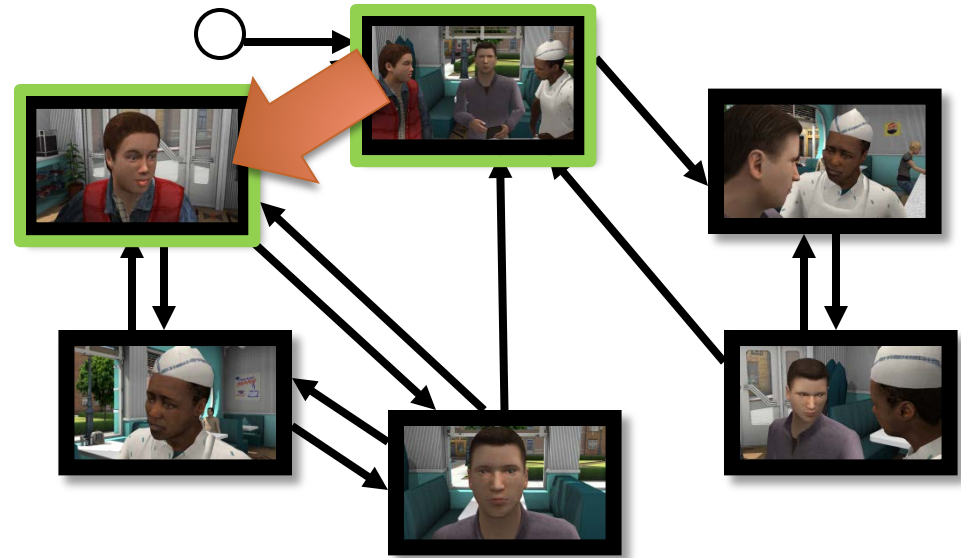


Scenario

Idiom based solutions



Virtual cinematographer
[Christianson et al. 1996]

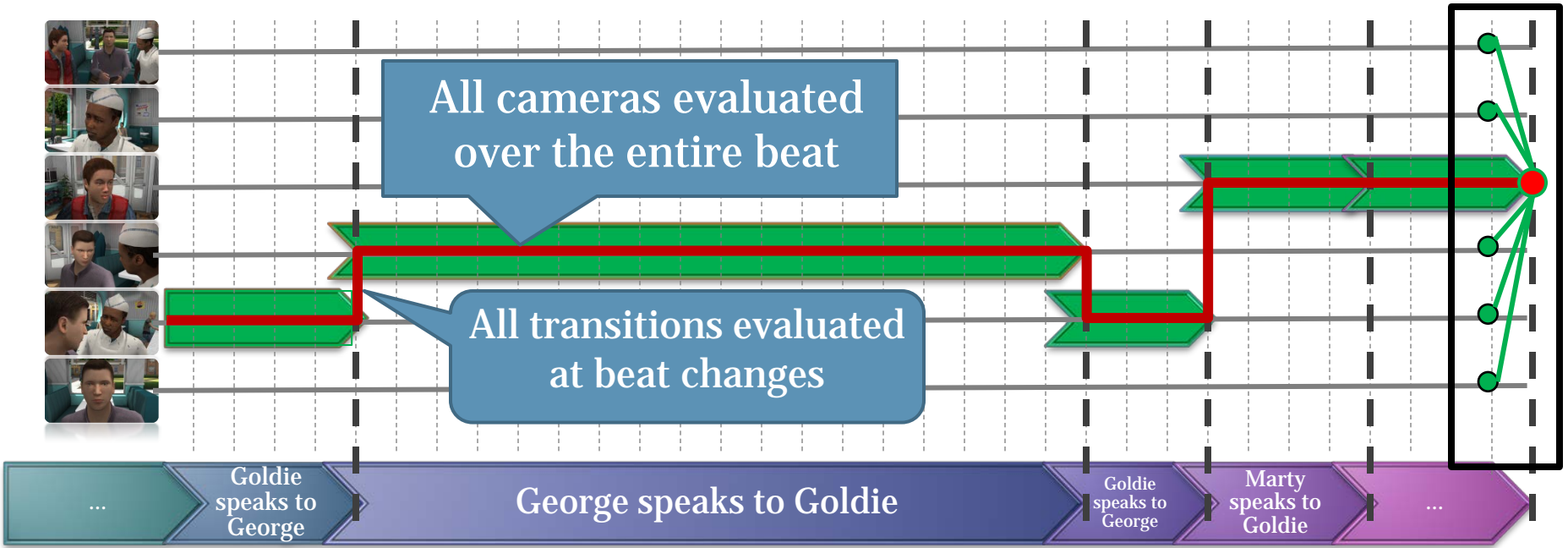


Scenario

Optimization based approach
 Dynamic programming

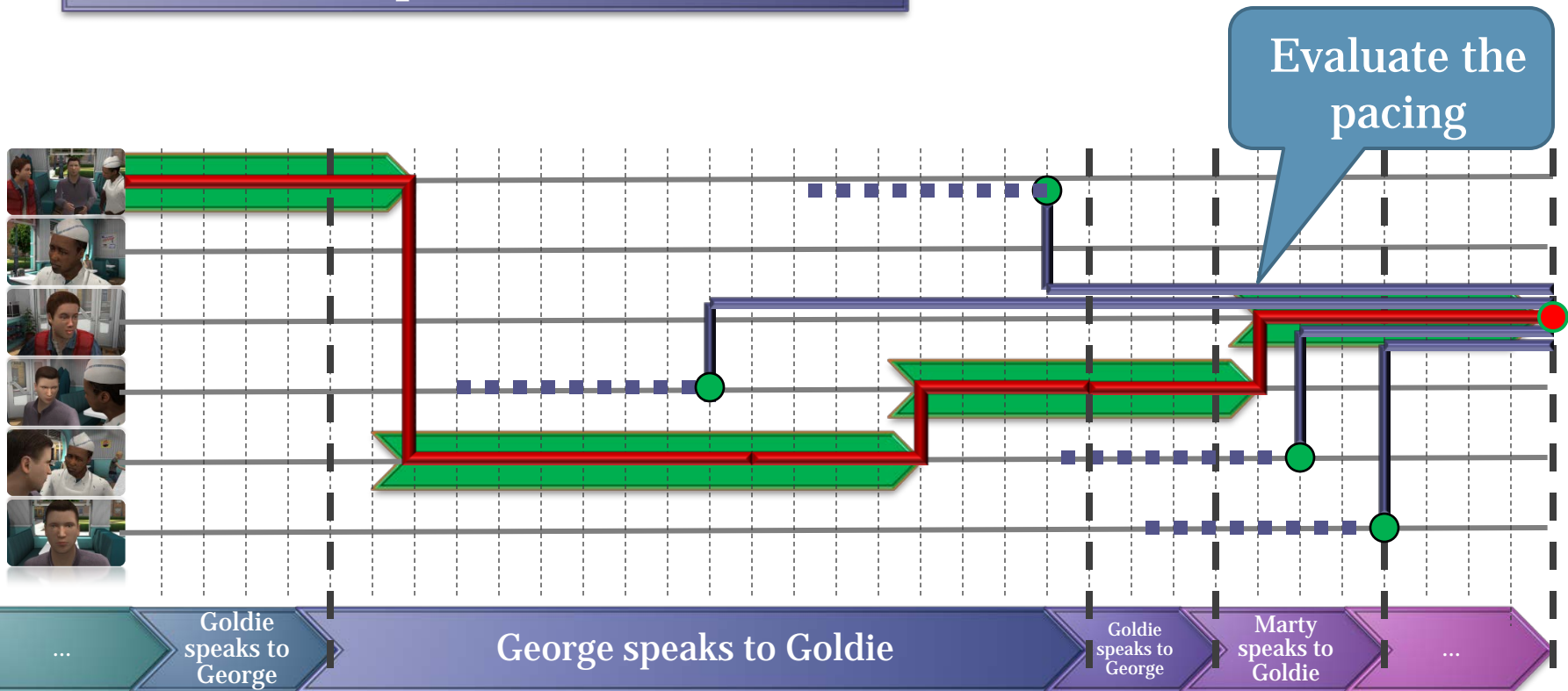


[Riedl, M. et al., 2008]



Scenario

Evaluate all possible transitions



Scenario

- Film editing as an optimization problem
 - Semi-Markov chains
- Create an editing graph that evaluates 3 aspects:

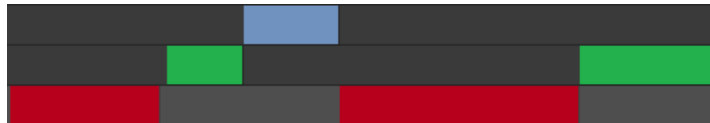
- Shot quality



- Cut quality



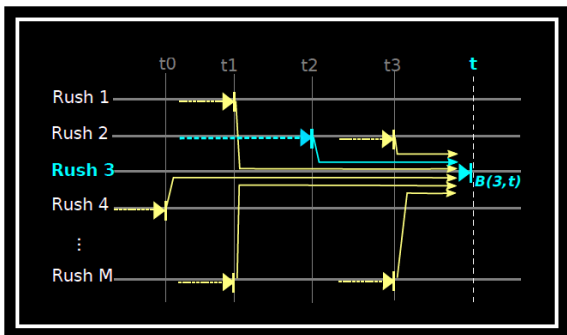
- Pacing



➤ Search over semi-Markov chains $s = (r_j, d_j)$ given actions $a(t)$

➤ Minimize cost function:

$$C(s, a) = \underbrace{\sum_j \sum_{t_j \leq t \leq t_j + d_j} C^A(r_j, t)}_{\text{Action cost (Shot quality)}} + \underbrace{\sum_{1 \leq j} C^T(r_{j-1}, r_j, t_j)}_{\text{Transition cost (Cut quality)}} + \underbrace{\sum_j C^R(d_j)}_{\text{Rhythm cost (Pacing Quality)}}$$



The final editing is given by the shortest path in the editing graph

➤ Shot quality evaluated using:

- Action proximity
- Ensure that the cameras best cover the actions

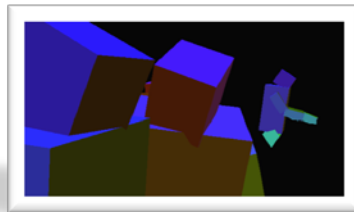
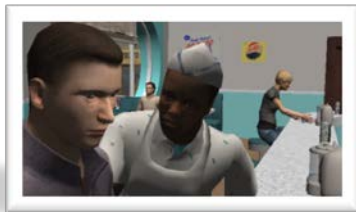
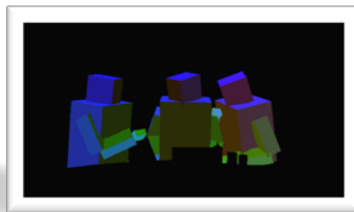


$$C_P^A(r, t) = 1 - \sum_c V(c, r, t)$$



➤ Shot quality:

▪ Visibility computation



Compute:

➤ Occluded area

+

➤ Offscreen area

$$C_V^A(r, t) = \sum_{c \in C} \sum_{b \in c} \sum_{f \in b} I(f, t) \cdot \frac{O(f, r, t)}{S(f, r, t)}$$

➤ Shot quality:

▪ Hitchcock principle

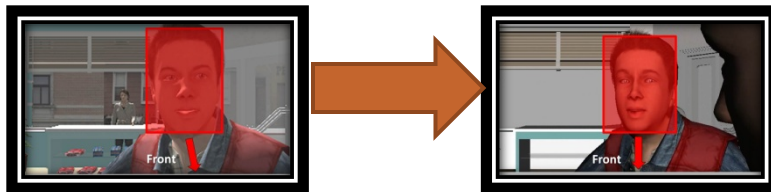
The size of a character on the screen should be proportional to its narrative importance in the story.

- Narrative importance from script
- Visible area $V = S - O$ for each rush

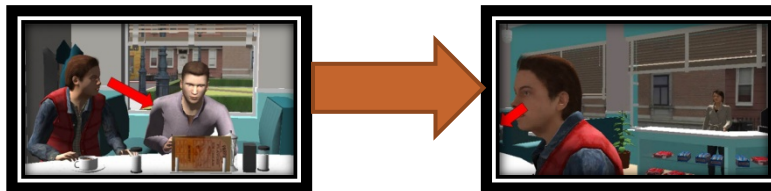
$$C_H^A(r, t) = \sum_{c \in \mathcal{C}} \left| \frac{I(c, t)}{\sum_{c'} I(c', t)} - \frac{V(c, r, t)}{\sum_{c'} V(c', r, t)} \right|$$

➤ Cut quality:

➤ Jump cuts



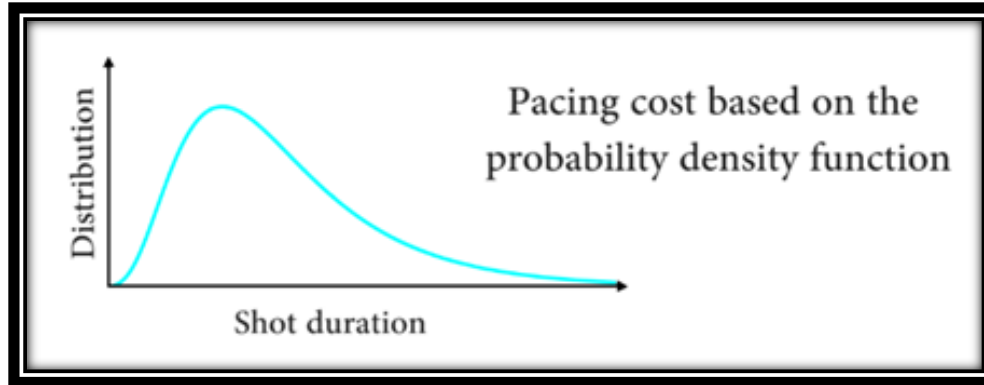
➤ Screen, motion and gaze continuity



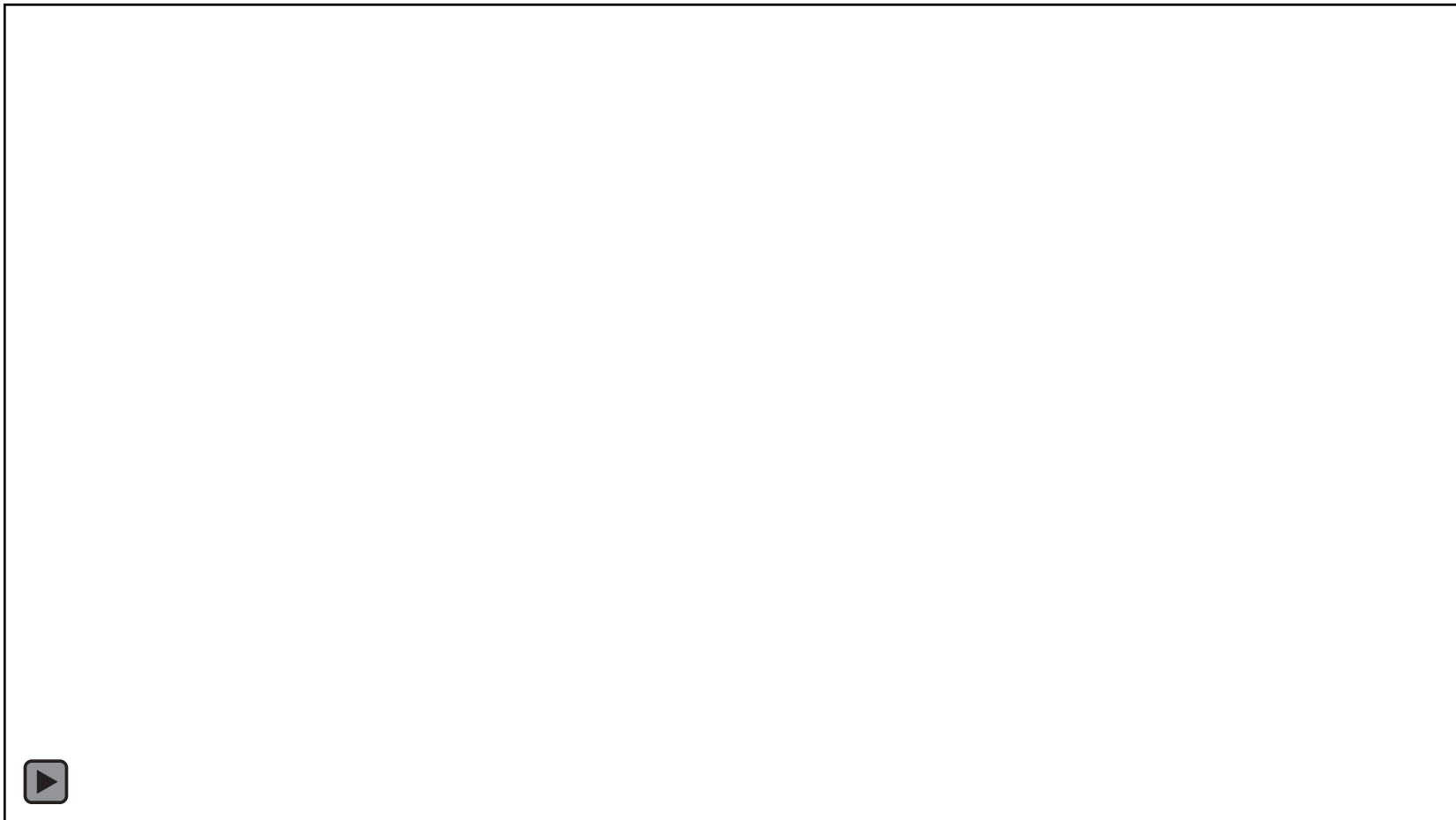
➤ Left-to-right ordering

➤ Pacing

- Shot durations follow a log-normal distribution



$$C^R(d_j) = \frac{(\log d_j - \mu)^2}{2\sigma^2} + \log d_j$$



- 3 different versions edited:
 - Original pacing
 - Slower pacing
 - Faster pacing

- User study: confirms that all 3 terms are important
 - Shot quality, cut quality and pacing

Limitations

- Cameras must be pre-computed

- Cannot handle book-ending
 - Context free grammar

- Cannot handle ellipsis or flashbacks

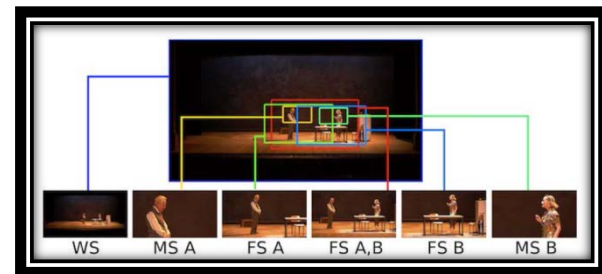
Future work

- Optimize over camera positions and movements



[Galvane et al., 2014]

- Extend to real live video



[Gandhi et al., 2014]

- Learn cost function from real movies

- Computational model for film editing
- Incorporate knowledge about shot composition and film grammar
- Efficient offline algorithm
- Suitable for automatic film making

Dataset and results:

- *<https://team.inria.fr/imagine/continuity-editing/>*

