

Innovative Gameplay Using Time Travel and Time Manipulation

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Time Travel is Here: Achron

- Free-form time travel
- Multiplayer
- CPU & memory now sufficient
- Demo...

Outline

- Time travel taxonomy
 - Sci-fi
 - Games
- Time travel & gameplay: implications & isomorphisms
 - Undoing
 - Reversing
 - Time velocities
 - Editing timeline
 - Chronoporting
 - Overlaying vs branching
- Time mechanisms and game development

Time Travel in Science Fiction

- Immutable timeline
 - Predestination paradox: *12 Monkeys*
- Mutable timeline
 - New “layers”: *Primer*
 - Dimensions of time > 1 : *The Time Ships*
 - Merging changes: *Back to the Future*
 - Precognition: *The Shining*

Time Travel in Science Fiction (2)

- Repeat timeline: *Groundhog Day*
- Time wave propagation
 - Instant: *The Butterfly Effect*
 - Velocity: *Back to the Future*
- Traveling through time
 - Instant: *Doctor Who*
 - Velocity: *The Time Machine*

Time Travel in Games

- Story only
- Time zones
- Time loop
- Reverse time
- Fixed jump back
- Free-form

Story Only

Command & Conquer



Time Zones

Chrono Trigger



Singularity



Darkest of Days



Time Loop

Majora's Mask



Reverse Time

TimeShift



Braid

Fixed Jump Back

The Misadventures of P.B. Winterbottom



Free-Form

Achron



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Why Add Time Manipulation?

- A new/different gameplay experience
- IP / franchise
- Difficulty forgiveness; less time to master game
 - Older core gamers
 - Slower thumbs
- Serious Games
 - Teach causality
 - Sensitivity analysis of simulation
 - Collaborative planning

Overview of Time Gameplay Mechanisms

- Undo / alter past
- Reverse / change direction
- Edit timeline
- Chronoport (transfer things across time)
- Timeline overlay & branching

Undo

- Save state & quick load
- Play perfect game
- Transformative:
 - NP Complete problems & branching
 - Isomorphisms

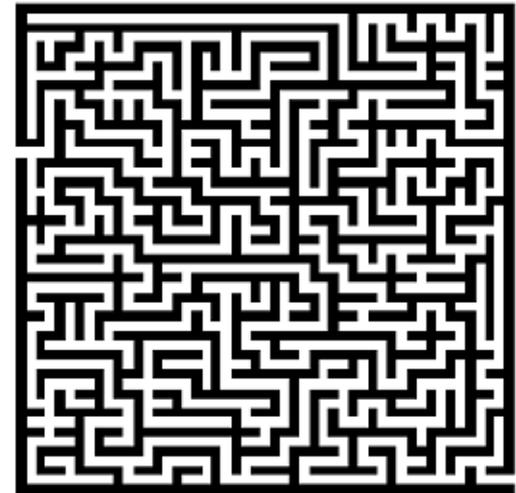
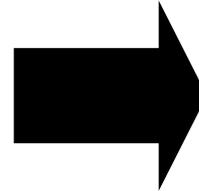
Undo Transformation 1

Obstacle/Combat Course



Final Fantasy 12

Maze



Undo Transformation 2

Battletoads



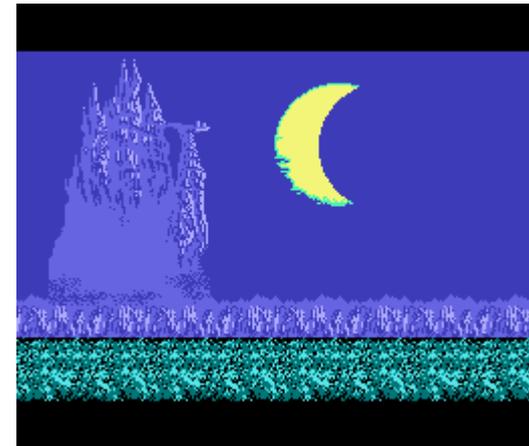
Ninja Gaiden



Winnable



Winnable

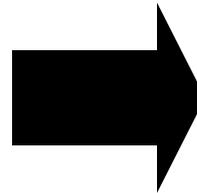


Reversibility

- Reversible computing
 - Difference (atomic) vs differential actions
 - Destruction of information
- System state stored as deltas
- Reconstructed by traversing timeline

Reversibility Transformation

R-Type



Guitar Hero



Retro/Grade



Independent Time Velocities

- Units, etc. (e.g., Singularity)
- Different causality velocities (e.g., Braid)

Edit Timeline

- Orthogonal to reversibility
- System state able to be reconstructed instantly
- Trade-off between memory (ratio of “keyframes” to deltas)
- Merge vs branch vs stability

Edit Timeline: Propagation

- Instant: expensive, difficulty w/ paradoxes
- Never: overlay, follow player
- Time waves
 - Speed
 - Distance between (smoothness)
 - Spawning process
 - CPU & Cache
- Player as a time wave

Edit Timeline: Info Categories

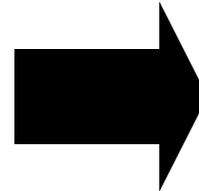
- A map of time
 - When X happened
- To inform of ability/need of attention
 - You can perform Y here
- Changes to timeline
 - Your opponent just changed Z
 - Time waves

Edit Timeline: Time as a Resource

- “Chronoenergy”
 - Non-linearity
 - Recharge
 - Spending
- Chronoenergy consumption
 - Grouped consumption: non-local effect
 - Hierarchical controls: local effect + mgmt assist

Edit Timeline: Transformation 1

Gran Turismo

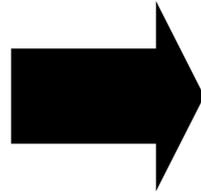


Sudoku (timed)

		1						
		2		3				4
			5			6		7
5			1	4				
	7						2	
				7	8			9
8		7			9			
4				6		3		
						5		

Edit Timeline: Transformation 2

Street Fighter 4

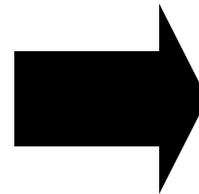


Street Fighter 4



Edit Timeline: Transformation 3

Dead Space



Not Scary



from <http://cuteoverload.com>

Chronoporting

★ **AxeManiac**
Nov 13, 2000

Have you seen this unit?

☑ *AxeManiac attached this image:*

DUKE'S BROS

★ Always bet on Admins ★



2 Mar 27, 2009 20:57

<http://forums.somethingawful.com/showthread.php?threadid=3106085#post358560692>

Managing Chronoclones

- Control
- Enumeration: name vs reference/handle
- Procedural content based on name
- Cause & effect
 - Age: older comes from younger

Chronoclones Strategies

- Permanent chronoclone “grief”
 - Cause: prevent chronoport at edge of time window
 - Carrier units, multiple chronoports
- Grandfather paradox arbitrage
 - Destroy factory that created unit
 - Unit produced for free
- Cloned resources, resource processors, buildings

Overlaying

- “Hometime”
- Updating/merging timeline
 - Player disassociation with avatar
 - RPG (some), RTS & RTT, Sports, 3rd person shooter, simulation games
 - Better for multiplayer
 - Attracting states & fixed points
 - Being own parent – fixed point, but not attracting
 - *Minority Report* – non-attracting fixed point

Time Branching & Merging

- Causality overlay (branching timeline)
 - Association with avatar
 - FPS, platformer, traditional MMORPG
 - Better for single player
- When to merge?
- Multiple players
- Reversibility issues

Preventing Confusion

- Leverage player memory of past
- Groundhog day effect
 - Accessibility: *Majora's Mask*
- Branch points & mental stack depth
- Tolerance for unobserved changes

Time Travel Effects on Development

- Helps to implement upfront
- Reversibility: permeate all actions
 - How to minimize deltas (CPU & mem)?
- Time travel & game state
 - Count bits
 - Quickly recreate query structures (spatial indexes, caches, etc.)
 - Lazy vs up front
 - Overtake start distance

Time Travel Effects Gotchas

- Meta-time weapons: meta-destroying a unit allows it to be created
- Player commands
 - Frame: relative vs absolute
 - Moving platforms/buildings
 - Prediction, lag, & Markov property
 - Resynchronization
- Distributed processing

Managing The Butterfly Effect

- Determinism
- Locality
- Visibility
- Agent/unit behavior

Time Travel Effects on Bugs

- Determinism!
- Upper-layer (e.g., scripting) bugs VERY easy
 - Save game *after* rare bug happens
 - Rewind/reverse & replay to reproduce
 - Save game is instant test case
- Lower-layer bugs VERY hard
 - Consistency bugs
 - Uninitialized vars/bad pointers REALLY bad
 - Log entire system state, find first diff

Conclusions

- Multiple orthogonal time mechanisms
- Decide on temporal mechanic early in dev
- Think through implications
- Interface & controls important
- Lots of untried possibilities
- Pushes player to think