A detailed collage of items from the Uncharted series. In the top left is a handheld GPS device showing a map. Below it is a green pen. To the right is a map with Roman numerals II, V, and VII. In the bottom left is a compass. In the bottom right is a key and a skull. A brown leather book with the title 'UNCHARTED Drake's Fortune' is also visible.

# Creating a Character in Uncharted: Drake's Fortune

Christian Gyrling  
Naughty Dog

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# Who Am I?

- Programmer at Naughty Dog
- Created the enemy characters in Uncharted
- Co-authored the AI.





# Talk Overview

- “The Problem”
- Character Animation Architecture
- Additive animations and how we used them
- Adding Variation
- Q & A



A detailed collage of items from the game Uncharted: Drake's Fortune. The background features a weathered map with handwritten notes and Roman numerals (II, V, VII). Scattered around the map are several brass bullets, a handheld GPS device showing a map, a brass compass, a brass key, and a small treasure chest with the 'UNCHARTED' logo. The overall lighting is dramatic, with a strong blue light source from the top left.

# THE PROBLEM

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UNCHARTED

NAUGHTY DOG

# Last Gen



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UNCHARTED

NAUGHTY DOG



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UNCHARTED

NAUGHTY DOG

BIGGER...



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**NAUGHTY DOG**

[illegible]

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# Bottom Line...

- Expecting 10 – 20x of last console generations animation count
- More complex animation blend trees
- 1 programmer and 1 animator for every two characters



# Things To Address

- Game Play - Scope
  - We can not make EVERYTHING better!
  - What parts should we make better?
- Asset Creation – Iteration Time
  - How to create all these animations
- Programming - Complexity
  - Organizing Animations
  - AI and Animation – More Complex AI Code?





# GAME PLAY

Scope

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# Meet the Enemy



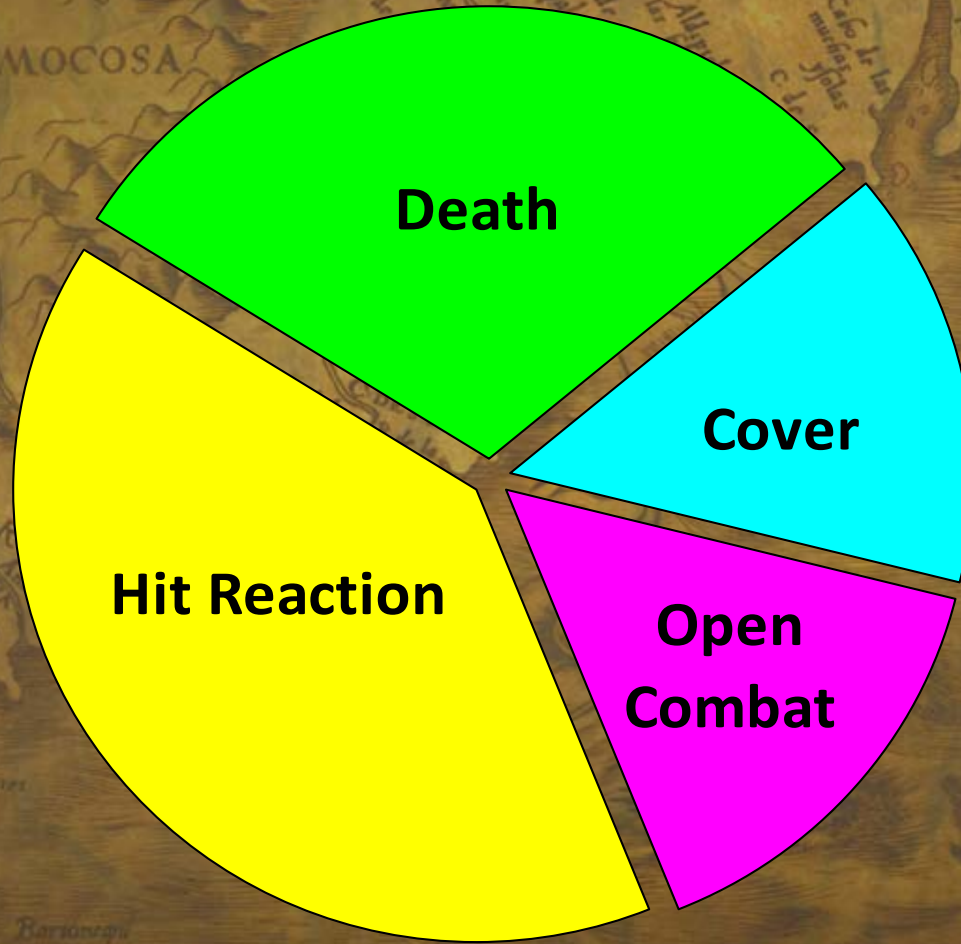
Pirate



Mercenary



# What Needs Variation?







# ASSET CREATION

Iteration Time

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# Problems

- Lots of animation files
  - Slow to open referenced scenes in Maya
  - Mismatching key-frames
- Verify and polish
  - Play the new animation in-game
  - Tune blends



# Solutions

- Fewer files...
  - Related animations in same Maya file
    - Works with only 1 animator per character
  - Key-frames are quickly copied/verified
    - Fewer bugs



# Solutions

- See things in-game 'fast'
  - In-Game Character Animation Test Bed
    - Maya to Controlling Npc – ~1 minute
  - Fast Animation Asset Creation / Renaming
    - Setup new animation – ~1 minute
  - Reloading of Animation Scripts
    - Rebuild and reload scripts – ~30 sec



A detailed collage of adventure-themed items. In the top left, a handheld GPS device shows a map. Below it, several bullets are scattered. A large, aged map with handwritten notes and Roman numerals (II, V, VII) is the central focus. To the left of the map is a circular compass. In the bottom right, a treasure chest is visible with a label that reads "UNCHARTED Drake's Fortune".

# AI & ANIMATION

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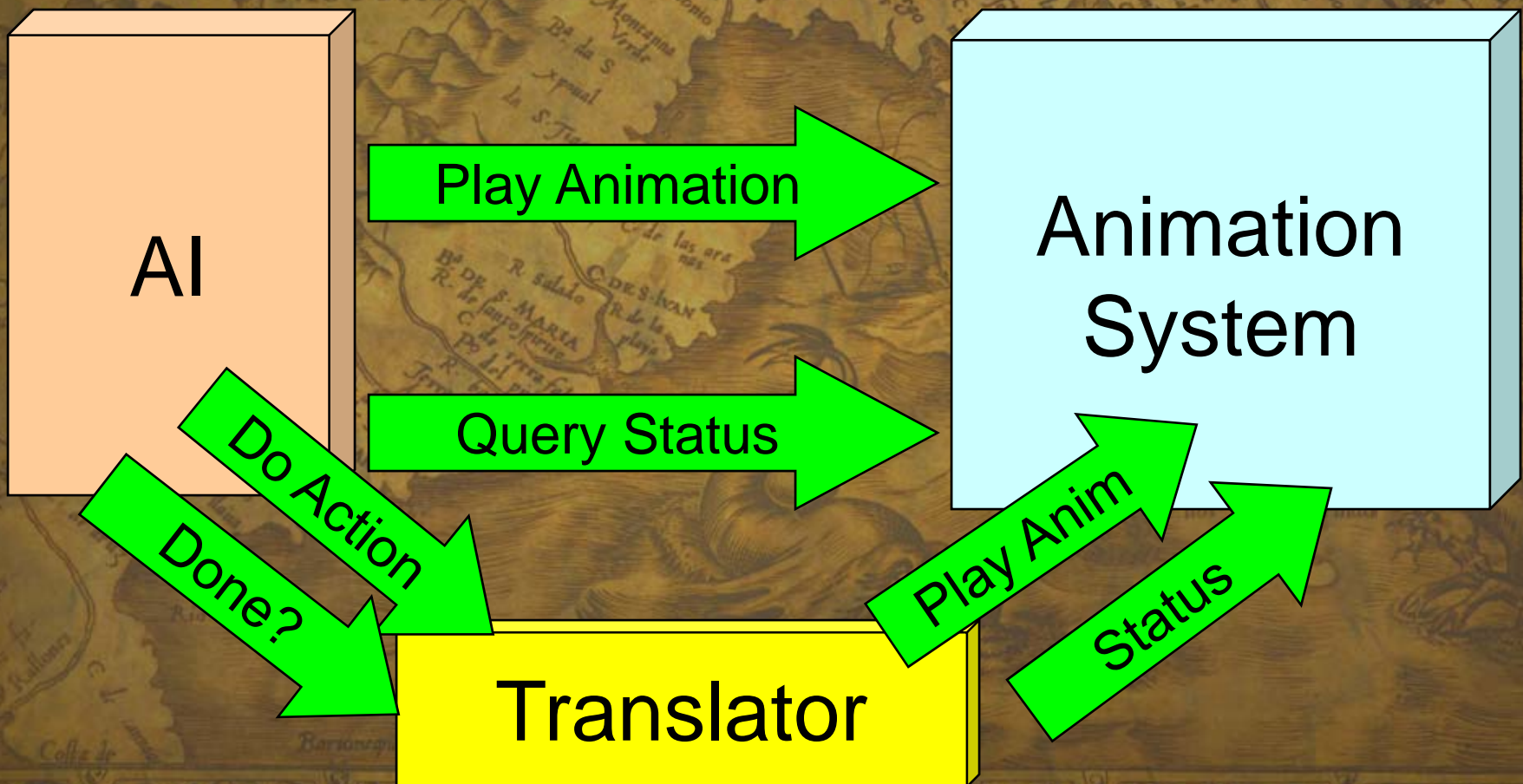


# Needed AI Functionality

- Basic
  - Request Animation
  - Wait For Animation
  - Status - Playing any animations?
- Special
  - Play animations relative to objects in the world (action pack animations)



# The Animation Interface





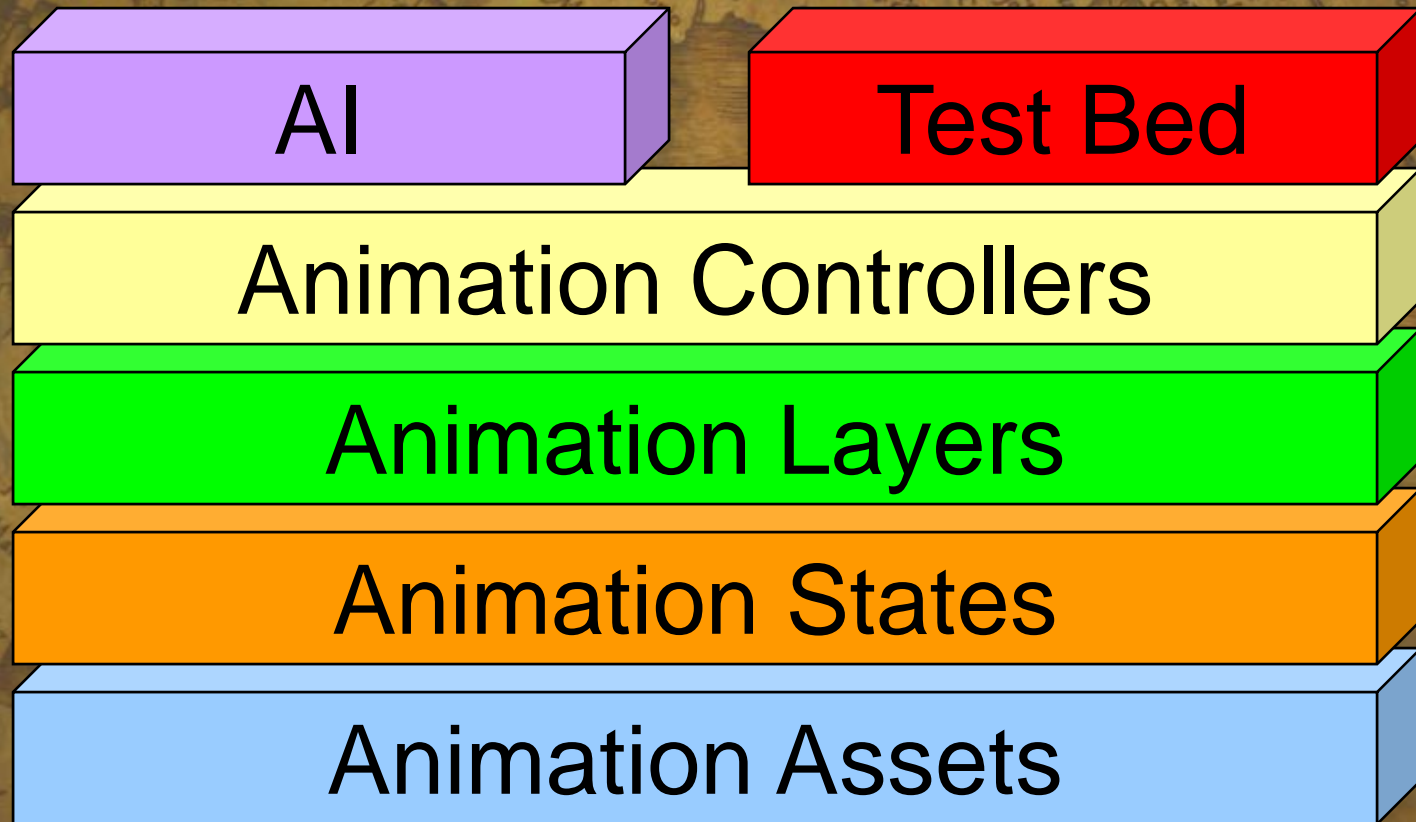
A collage of adventure-themed items including a handheld GPS, a map, a compass, a key, and a book titled 'UNCHARTED'. The background is a dark, textured surface with various objects scattered across it. The title 'Character Animation Architecture' is prominently displayed in the center in a large, white, bold font.

# Character Animation Architecture

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# Character Animation Architecture





# Animation Assets

AI

Test Bed

Animation Controllers

Animation Layers

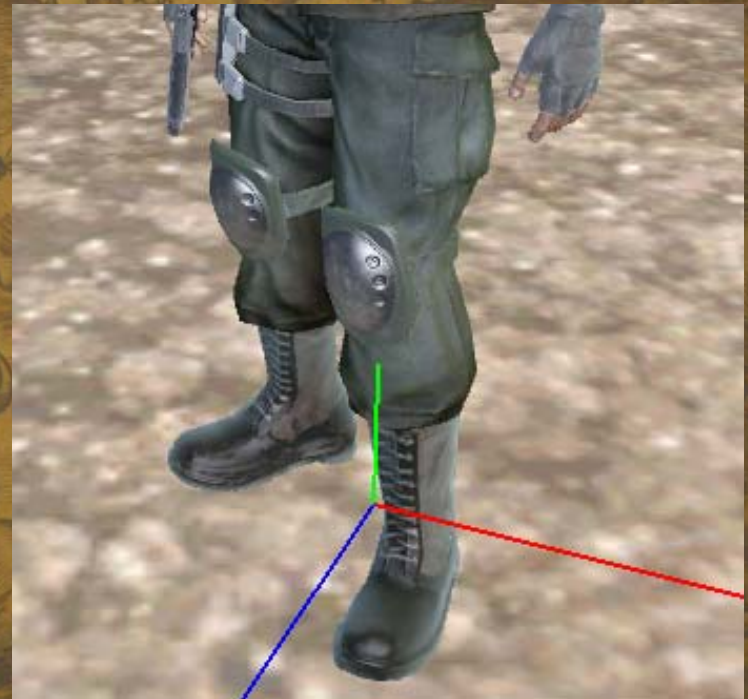
Animation States

Animation Assets



# Character Locator

- Exist in all animations
- Motion is extracted from this locator
- Easy to blend between animations
- Used in 'action packs'
  - Relative to objects





# Action Packs

- Two Locators
  - Character Locator
  - Reference Locator
- World-relative animation play-back
- Examples:
  - Cover
  - Vehicles
  - Spawn Animations



[Video!!](#)



# What Is An Additive Animation?

Tired Run

=

Run

=

Additive Anim – ‘Tired’



# What Is An Additive Animation?

[Video!!](#)

Walk

Run

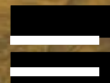
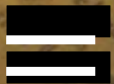
Jog



Tired

Tired

Tired



Tired Walk

Tired Run

Tired Jog



# Animation States

AI

Test Bed

Animation Controllers

Animation Layers

Animation States

Animation Assets



# Animation States

- Centered around a character action
- Contains transitions to all other possible states
- Semi-Static animation blend tree
- Defined in script (DC)
  - “Adventures in Data Compilation”
  - 2:30 PM – Room 3020 - Dan Liebgold



# Transitions

- Action Based
  - Run, Stop, Exit...
- Contains
  - Next State
  - Blend Time
  - Blend Curve (Linear, Ease In/Out...)
  - Guards
    - IF MoveAngle > 80° Then...
- Transitions added without code changes



# Transitions

IDLE

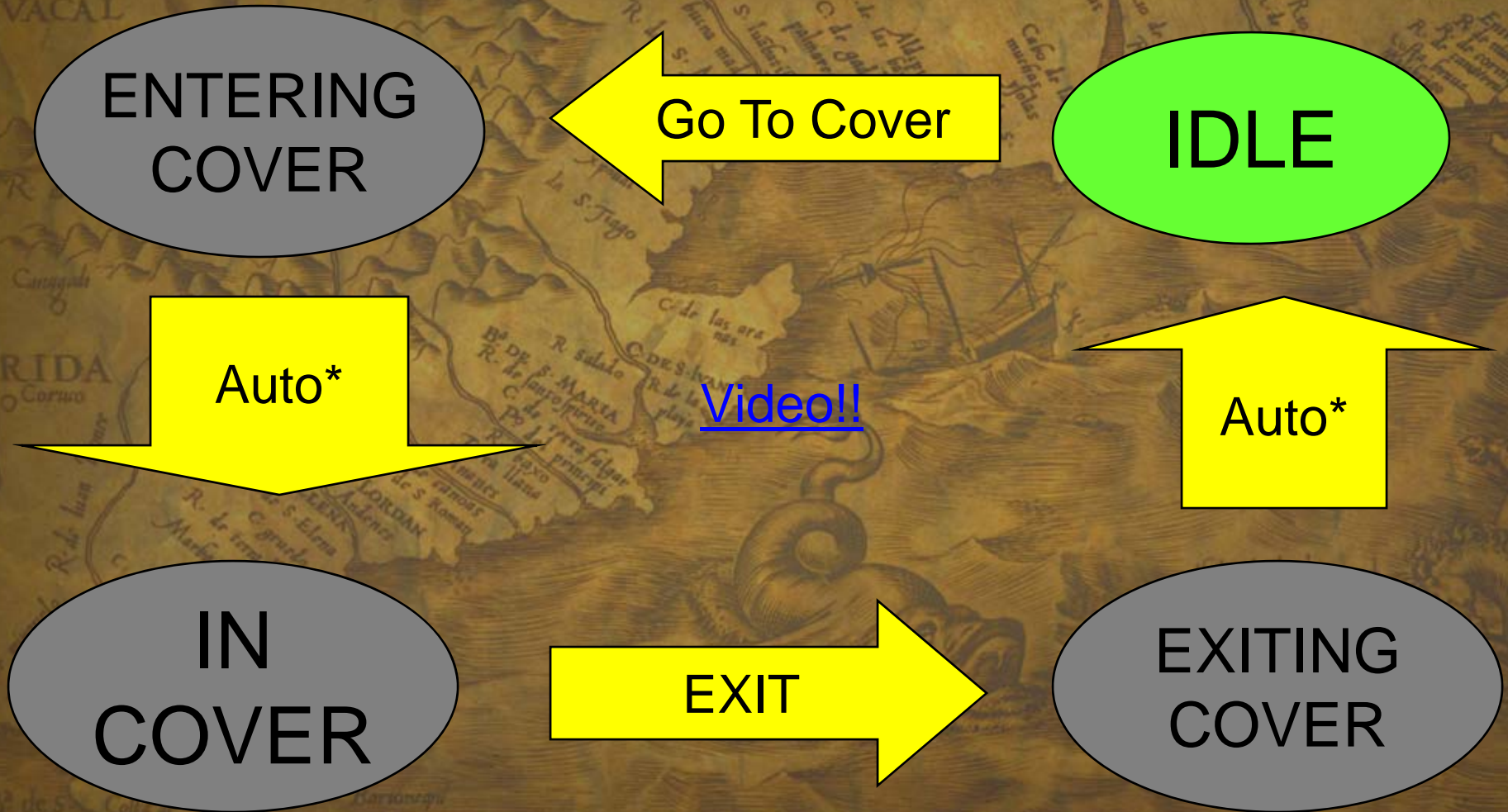
Go To Cover

EXIT

IN  
COVER

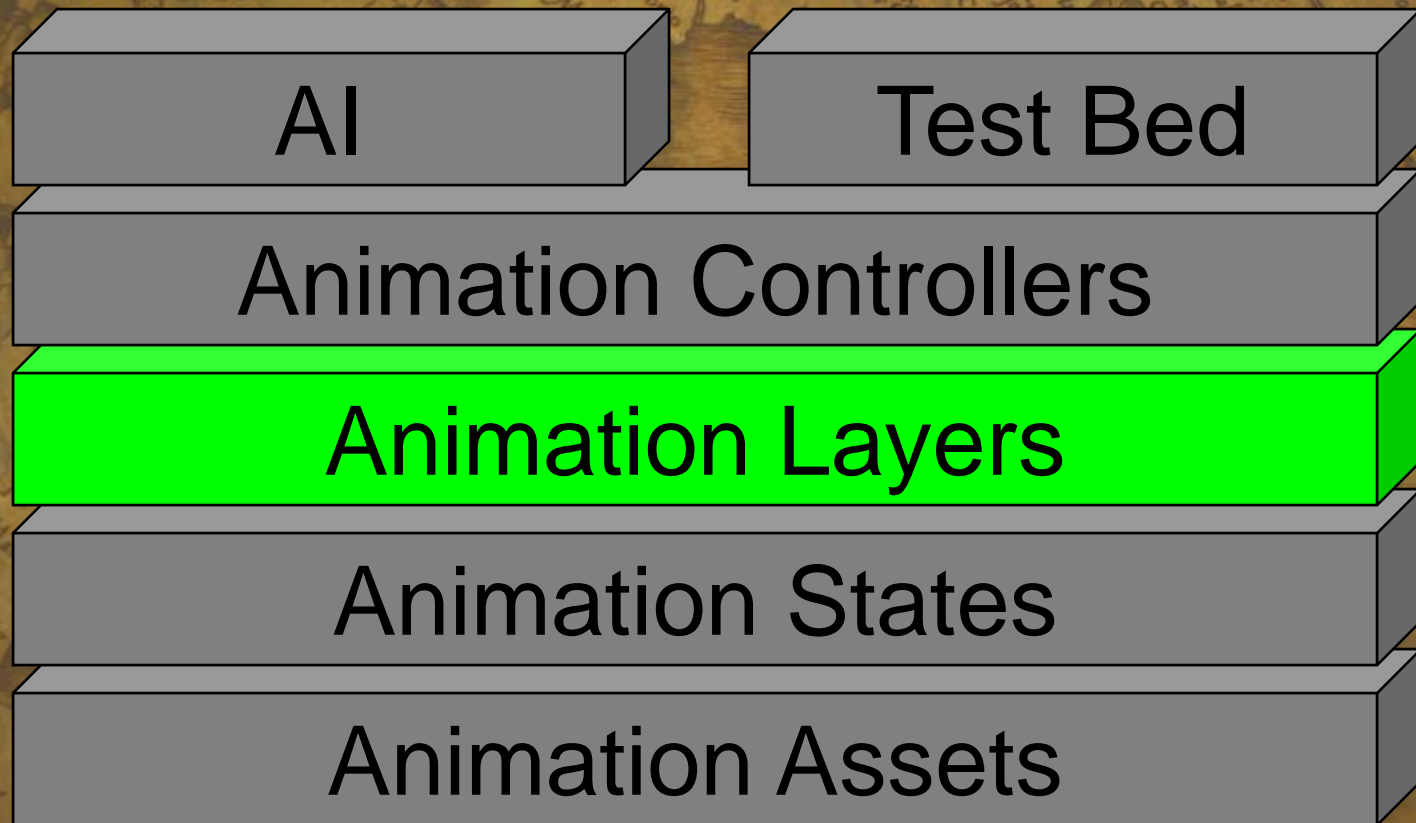


# Transitions





# Character Animation Architecture





# Animation Layers

- Independent Actions
  - Moving
  - Breathing
  - Facial Animations
- Has a selected animation state
- Blends between states during transitions
- Blended together to final pose



# Animation Layers

Facial – 160 Frames

Additive: Run Noise – 300 Frames

Run - 30 Frames

Run - 30 Frames

Run - 30 Frames

Run - 30 Frames

[Video!!](#)



# Animation Controllers

AI

Test Bed

Animation Controllers

Animation Layers

Animation States

Animation Assets



# Animation Controllers

- Used To Control Character
  - Locomotion Controller
  - Weapon Controller
- ‘Action’ Interface
- Contract of making the character perform an action
- Maintains Character Status
  - Can new actions be requested?



# Animation Info

- Control Structure
- Second way of interfacing with the animation system
- Info from the game affecting the animation states
  - Modifies the animation blend tree at runtime
  - Ex: Blend aiming in / out

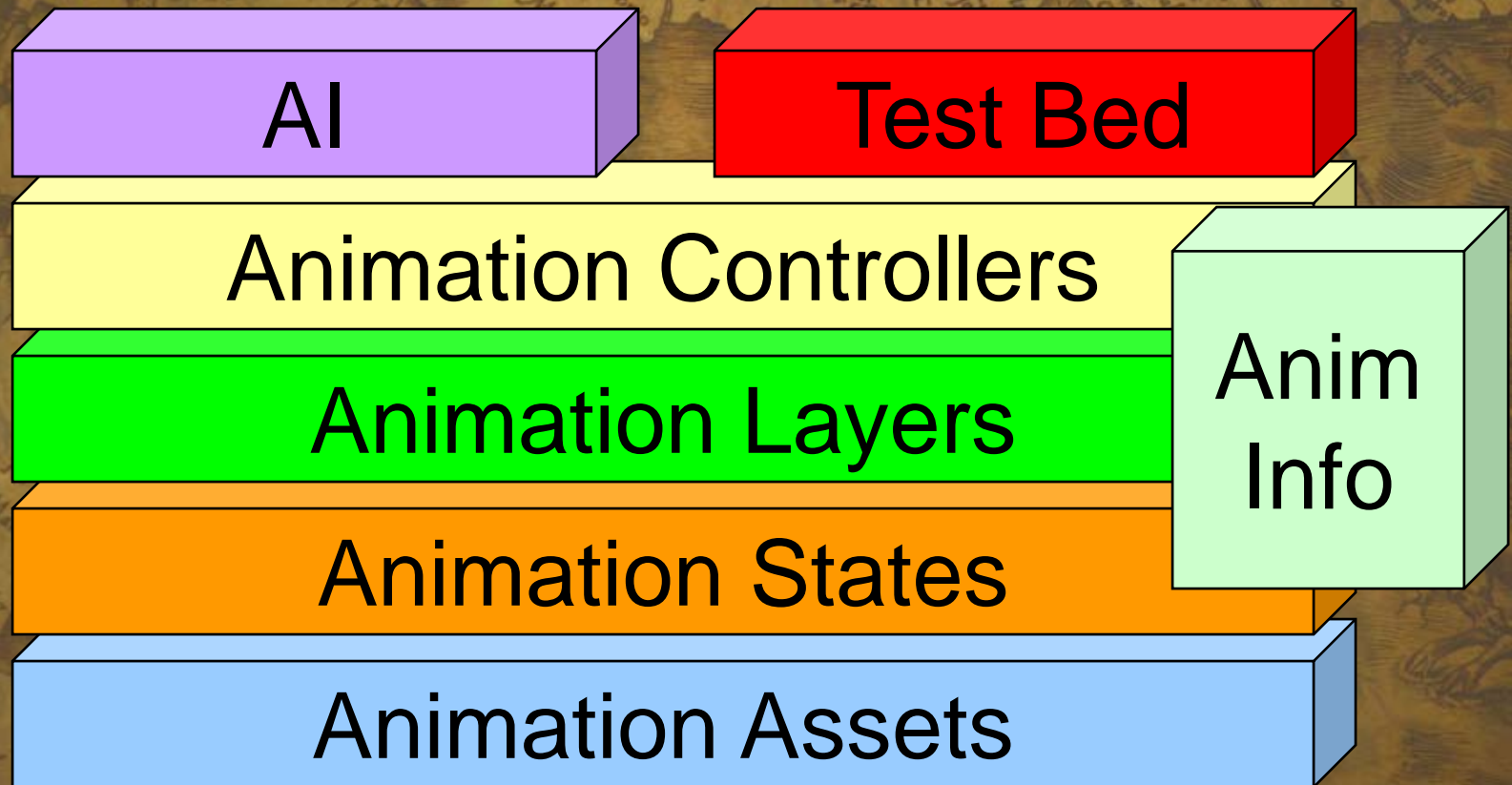


# Animation Info

- Movement Angle
  - Movement relative to forward direction
- Movement Angle Delta
  - Frame to Frame delta to detect special turns
- Aim and Look-At Angle
  - Control look-at direction
- Pose Selection Index



# Character Control Architecture






# Requests Vs. Anim Info

- State changes in the AI often lead to a new action request (anim state change)
  - Enter cover
  - React to bullet / explosion [Video!!](#)
- Smaller AI adjustments result in anim info changes.
  - Movement direction
  - Look-At and aim direction [Video!!](#)



A collage of adventure-themed items including a handheld GPS, a map, a compass, a key, and a skull.

# ADDITIVE ANIMATIONS

And how we used them...

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# Look – At & Aim

- Procedural IK on neck / spine joints
  - Skinning around neck got weird when in low poses.
- Partial Animations (neck/spine only)
  - Made the character look stiff
- Additive Animations
  - Preserve base animation motion (texture)



# Additive Approach

- Natural 'swaying' on arms and head
- Arms and head combined in Look-At
- Give the animator power to control the look and feel
  - Special look-at animation for each pose
- Animators will ALWAYS make things look better
  - If not... find better animators! ☺

[Video!!](#)



# Cost

- Runtime
  - Ice (similar to Edge) Animation Modules
  - Animation blending on the SPU is nearly free
  - 9 clips and 9 blends in normal battle – 10 us
    - Double or triple when changing directions
- Memory
  - Animation compression (< 1Kb each)
- Creation Time
  - Only takes a couple of minutes if animated in same file as the base animation



# Problems

- Unwanted Results
  - Hands and weapon not lining up
  - Not aiming at target
- Some Rules
  - Keep hip rotation in base anim to a minimum
  - Avoid rotations on arms and shoulders = **REALLY BAD!!**





A collage of treasure-themed items including a handheld GPS, a map, bullets, a compass, a key, and a skull.

# ADDING VARIATION

[Video!!](#)

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# Shipped Variations

- 60+ Deaths
- 70+ Hit reactions
- 80+ Gun-out poses
- 40+ Ways of entering cover
- and many more...





# Adding Variation



GAI

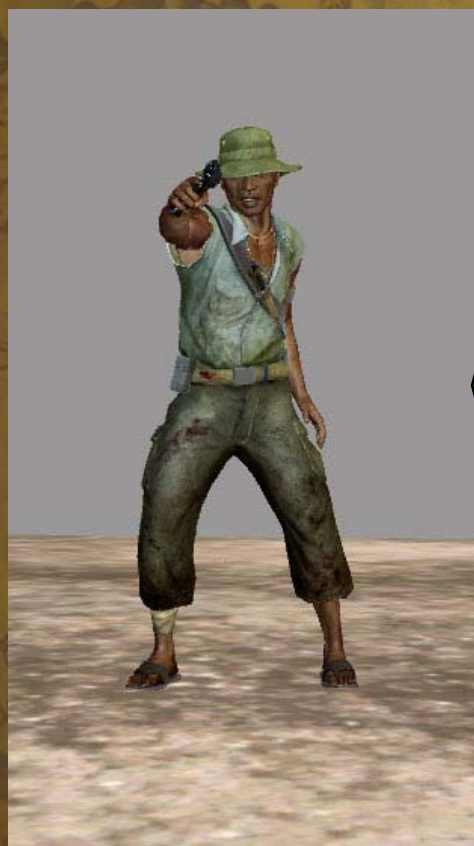
LOPE

ON F

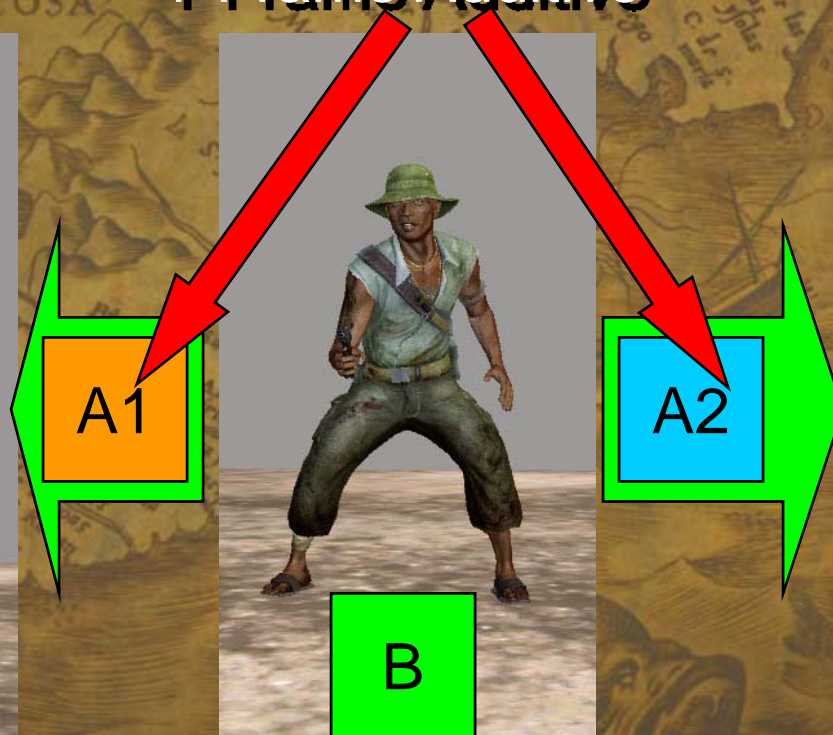


# Additive Poses

1-Frame Additive



Resulting pose



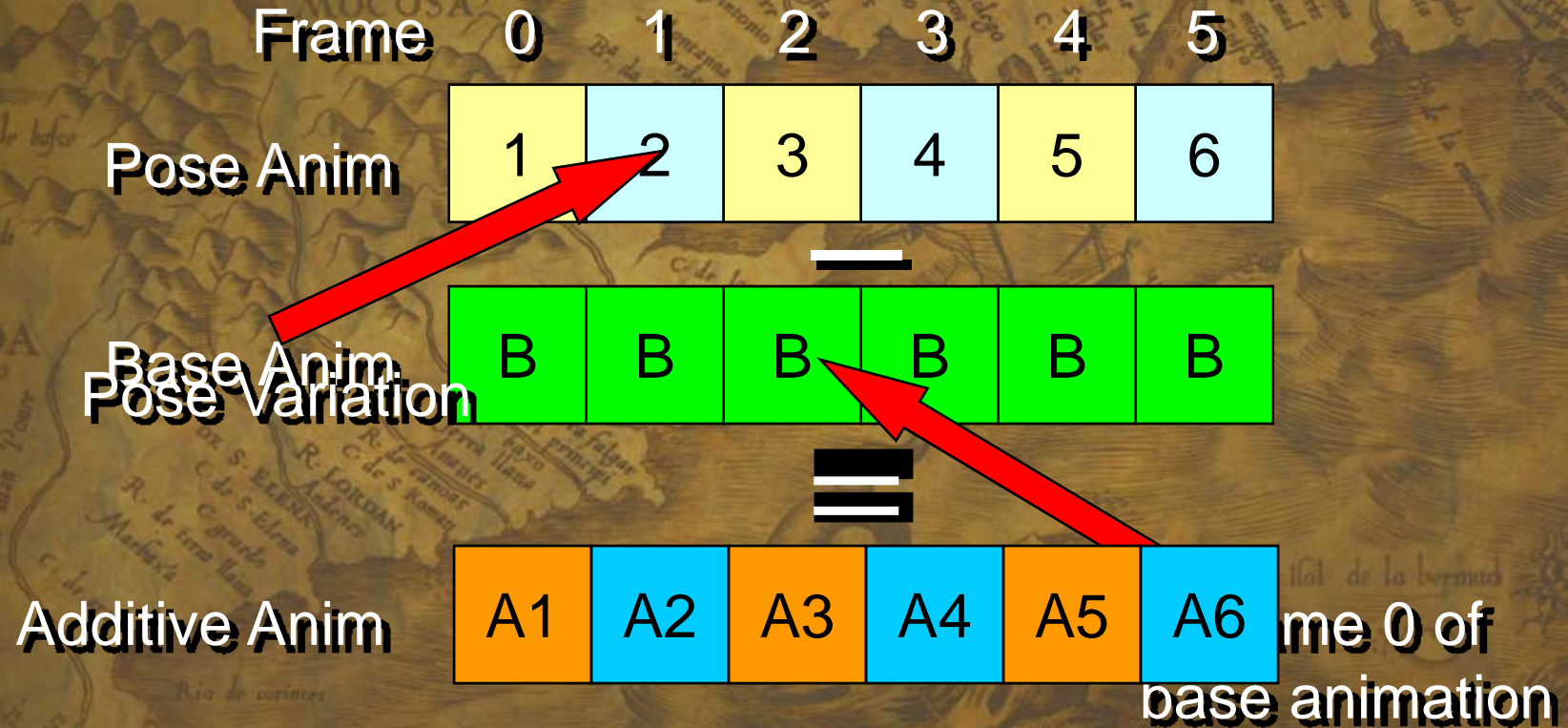
Base  
Animation



Resulting pose



# Pose Anim Layout



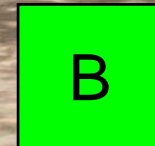
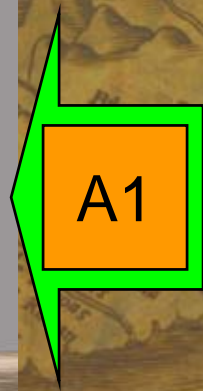


# Additive Poses

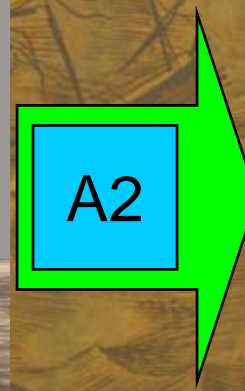
[Video!!](#)



Resulting pose



Base  
Animation



Resulting pose



# Careful....

- Unwanted Results
  - Severe swaying
  - Feet through the ground
  - Floating appearance
- Some Rules
  - No Y-translation on hip joints in base anim
  - Little to no hip rotation
    - Use rotated base anims
  - High and Low poses work great





# Using a Specific Pose

- Select a pose
- Update the Anim Info with the new index
- Make a transition request to state that utilize poses
- The animation state will add the selected pose to the base animation





# Implementation Details

- All pose selection logic is encapsulated in the animation controllers
- Randomness only in animation controllers
  - Hard to control otherwise... hard to test
  - No need to complicate the lower-level animation code
- Poses can be grouped and used only by certain characters types.



# Summary

- Choose wisely where to spend your time
- Hide animation complexity from the AI through the use of actions
- Animation states are autonomous
  - Can be tested / verified in isolation
  - No surprises
- Additive animation
  - Cheap
  - More power to the animators – Better Visual Quality



UNCHARTED

NAUGHTY DOG

# The Result



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# We are looking for talented people !

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# Q & A

Contact

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