GDC

UBISOFT

ACTION PLANNING ON ASSASSIN'S CREED ODYSSEY AND IMMORTALS FENYX RISING

SIMON GIRARD

ACTION PLANNING ON ASSASSIN'S CREED ODYSSEY AND IMMORTALS FENYX RISING

SIMON GIRARD

ABOUT ME

12 years
at Ubisoft
Quebec City

~7 years
AI Programmer

DON’T MISS

FIGHTING WITH DATA

Learnings from Building the Combat System in ‘Assassin’s Creed: Valhalla’

by

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SUMMARY

1

STARTING POINT

2

HOW DOES A PLANNER WORK?

3

RESULTS

Odyssey
&
Immortals

4

TOOLS

5

KEY LEARNINGS

DISCLAIMER

This is not a revolution in AI

It will not auto - magically make your AI smarter


PART 1
OUR STARTING POINT

SOME CONTEXT

We are here

Fall 2015

Fall 2018

Fall 2020

SOME CONTEXT

AI framework on AC has been running for over 10 years

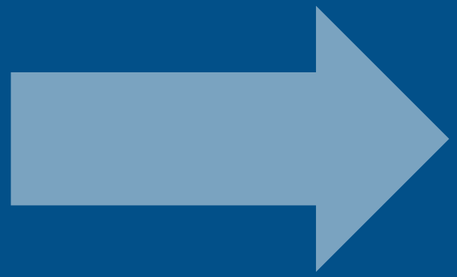
Our games have changed, but the underlying systems haven’t

TECH GOALS

REACTIVE AI

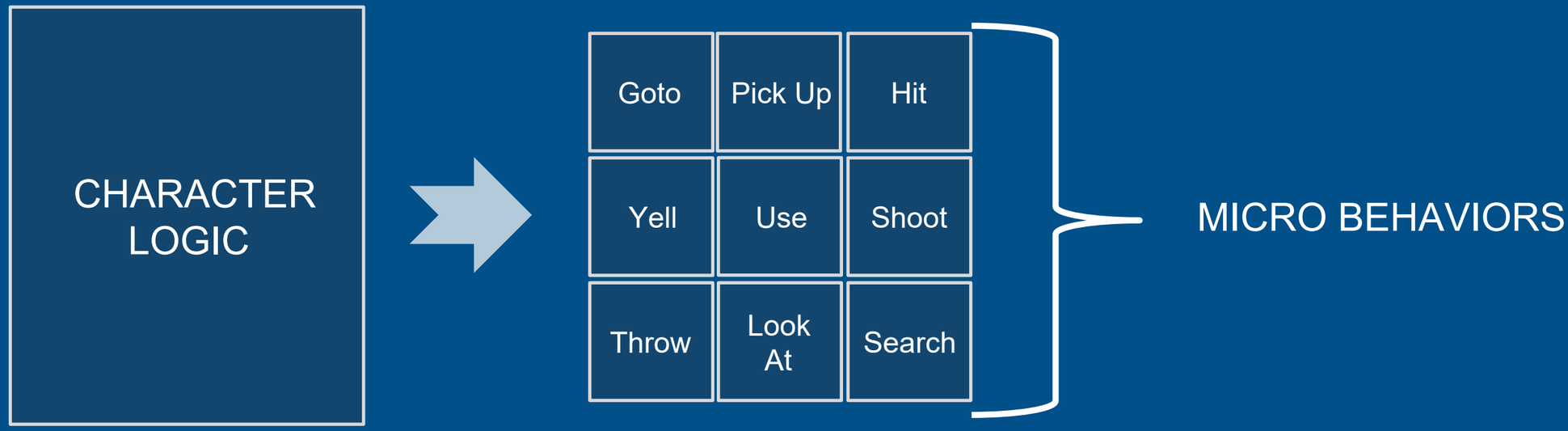
RECEIVES A STIMULI

EXECUTES A BEHAVIOR



TECH GOALS

BREAK DOWN MONOLITHIC SYSTEMS IN SMALLER, EASILY EDITABLE BLOCKS



PART 2

WHAT'S A PLANNER ?

WHAT'S A PLANNER

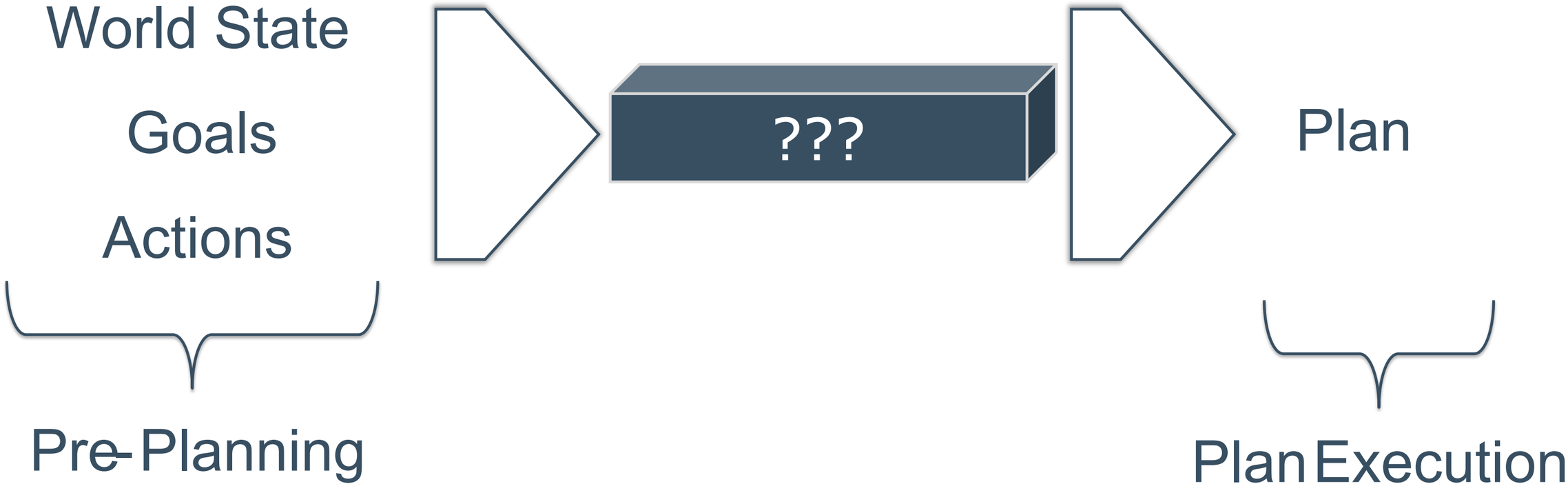
It's a decision-making system that finds a sequence of actions to solve a problem, by simulating the effects of the actions forward in time.

There are several implementations, the one we use is called Goal-Oriented Action Planning (GOAP)

It has existed in academia since 1971 (STRIPS)

It has been used in games starting with F.E.A.R. in 2001

PLANNING PROCESS



WORLD STATE

Snapshot of information to be used by the planner

We use a structure called a blackboard

Simple list of key-value pair

Contains all manner of things

Target

History of perceived stimuli

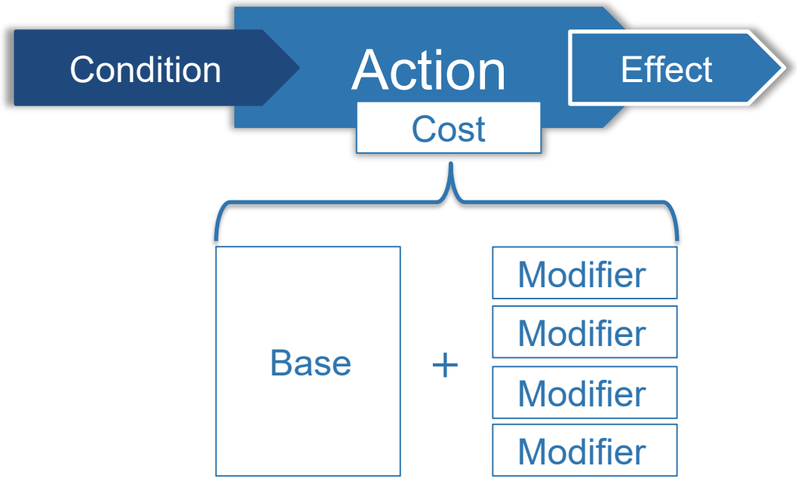
Far too many flags

PLANNER GOALS

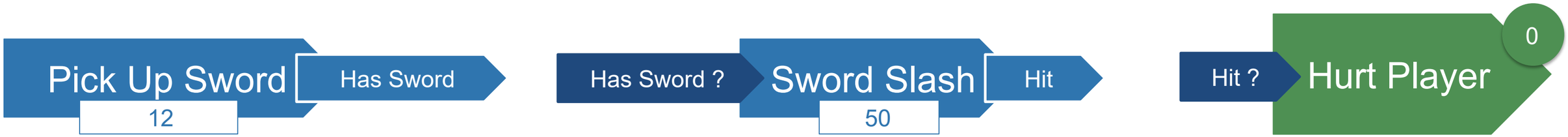
- The “problems” the planner is aiming to solve
- Defines a desired World State, using conditions
- Prioritized

PLANNERACTIONS

- Conditions and effects
- Cost
- List of runtime operations

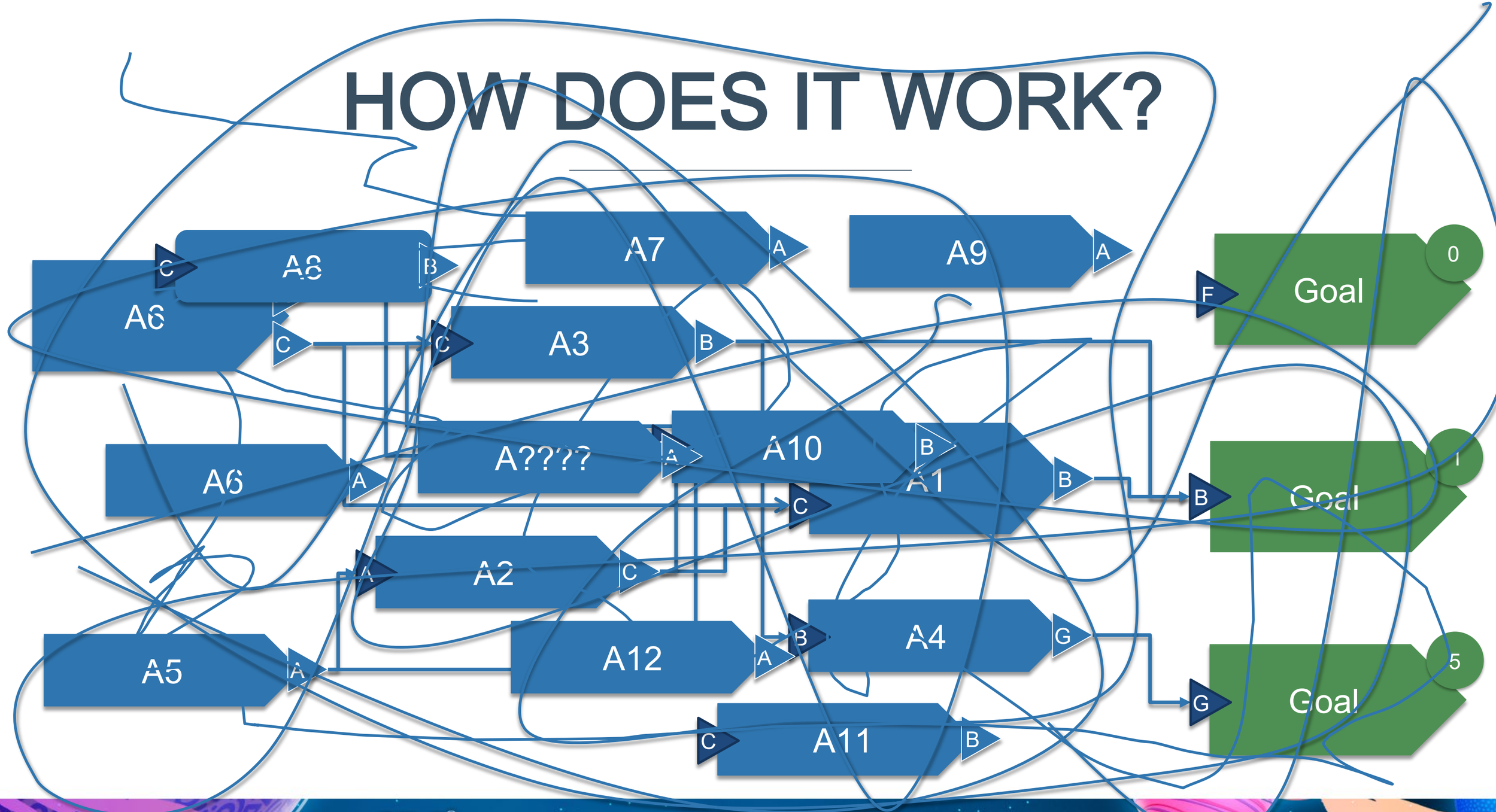


PLAN


Pick Up Sword
12
Has Sword
Has Sword ?
Sword Slash
50
Hit
Hit ?
Hurt Player
0


HOW DOES IT WORK?

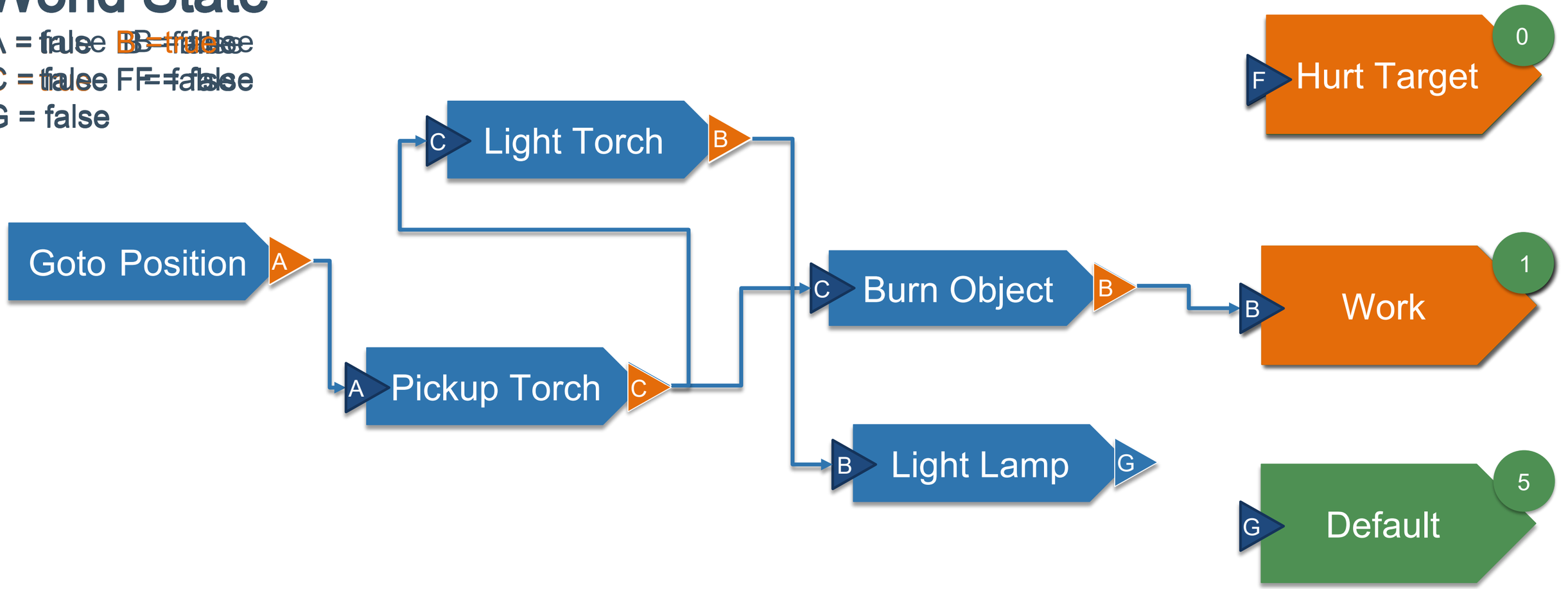
HOW DOES IT WORK?



FORWARD PLANNING

World State

A = false B = false
C = false F = false
G = false



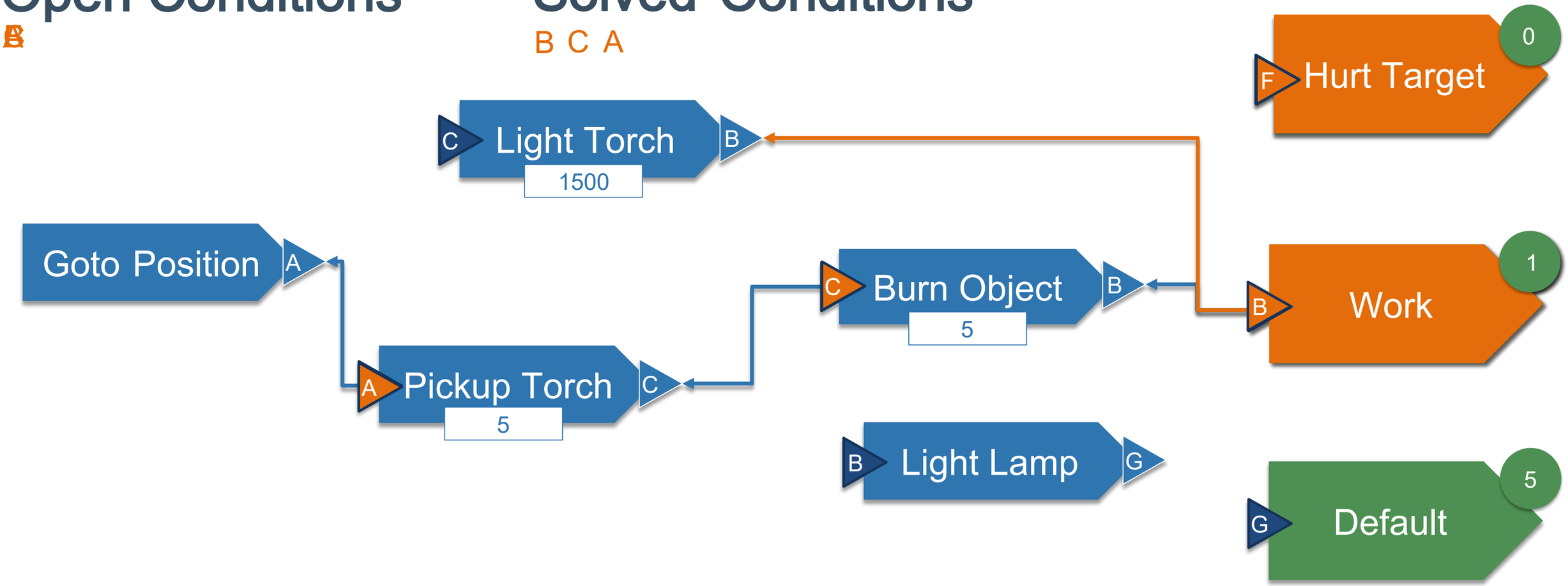
BACKWARD PLANNING

Open Conditions

A

Solved Conditions

B C A




PART 3
RESULTS


ODYSSEY

GAMEPLAY GOAL

THE NPCS HARDLY INTERACT WITH THEIR ENVIRONMENT

We spend all this time building worlds but only the player uses props in it

What if NPCs could use props around them as weapons?

INTRODUCING SMART OBJECTS

CONTAINS PLANNER ACTIONS
THAT ARE DYNAMICALLY ADDED TO THE PLANNER





Akrokorinth Fort
23
157 m
25
+15
Show Location Objectives


SO, DID IT WORK ?

RESULTS

Neat interactions with the environment

AI isn't doing anything radically different

TECH RESULTS

Short Plans

1 or 2 actions at most

Some actions can still be split

World State is limited

Limits planning possibilities

Some decisions are wrong

Modularity!

Tremendous improvement for production

OPTIMIZATION

NPC Contexts

Buckets of actions

Condition Sorting

Evaluate the conditions most likely to fail first

Done automatically

Periodic Planning

Plan when current plan ends

Plan every 0.1s

OPTIMIZATION

Pre-Validation

Prune goals & actions during pre-planning

Dependency Graph

Pre-build a list of dependencies between actions


IMMORTALS

TECH SCOPE

Expand planner capabilities

Improve debug tools

EXPAND CAPABILITIES

Re-evaluate costs at each planning step

Management of creature sizes using the planner

- Attack metrics

COST RE-EVALUATION

Re-evaluate costs before sequencing actions by applying action effects

More accurate World State leads to more planning possibilities

Handles a common case with distance-based costs

ATTACK METRICS

Natural use case for a planner

Different creature sizes mean different reach distances and heights

Cumbersome to craft by hand


A
B
5
LB


From Pain Comes Beauty
Scout the region from Aphrodite's statue
541 m
1
4
5
1
LB

GAMEPLAY SCOPE

Build behaviors from the ground up

Start from a clean slate

Smart Objects opportunities

Cyclops ripping trees from the ground

Boulder Throw


From Pain Comes Beauty
Scout the region from Aphrodite's statue
1347 m
1
3
5
1
LB

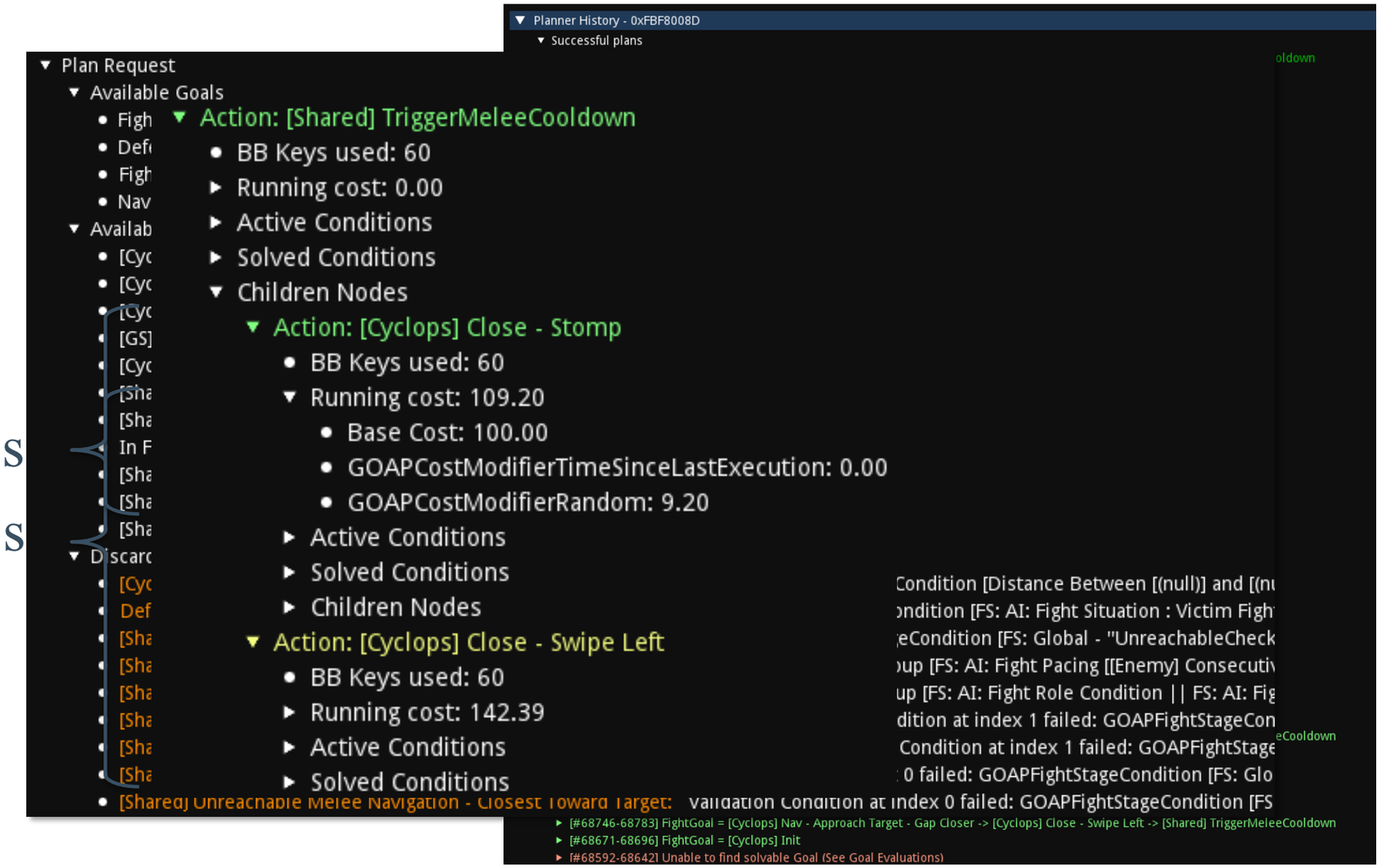

TOOLS

PLANNER MONITOR

Logs all evaluation branches

Much more user friendly than a breakpoint

Can be information-heavy for users unfamiliar with inner workings



GOAP STATISTICS

Execution mode that logs all condition evaluation (success, failure, selection in a plan)

Can perform automatic reordering of conditions

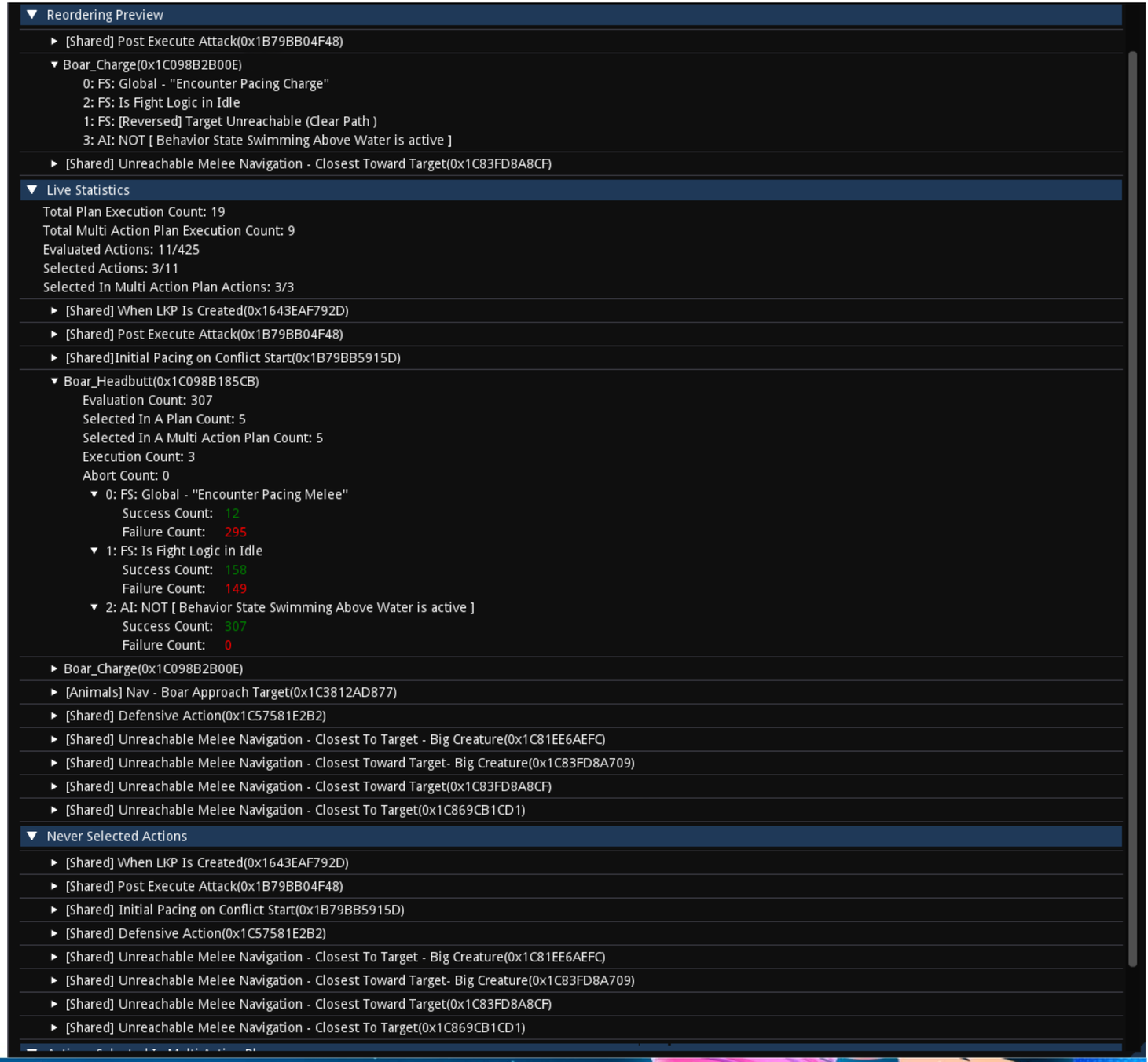
Reordering

Statistics

- Global usage stats
- Precondition success / failure

Usage Report

Helpful for debugging




TAKEAWAYS

TAKEAWAYS

THERE IS A SHIFT IN MINDSET REQUIRED FROM PROGRAMMERS AND DESIGNERS

Easy to try to script NPC behavior

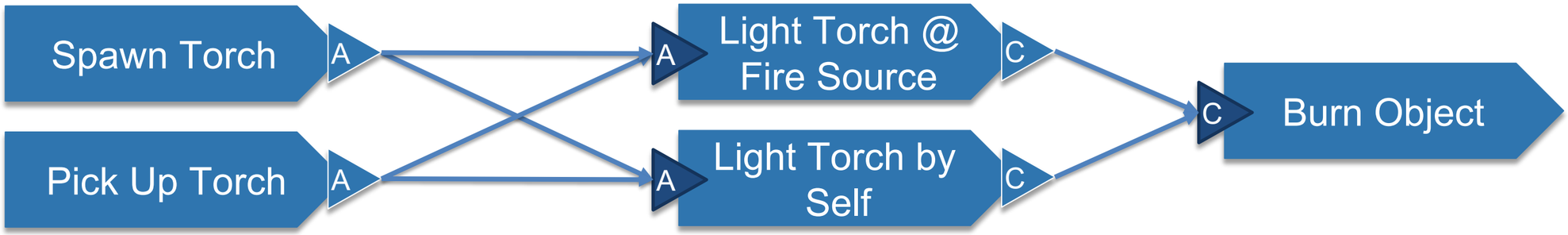
Planning isn’t fast

TAKEAWAYS

A PLANNER SHINES WHEN IT HAS MULTIPLE OPTIONS TO CHOOSE FROM

Strength of a planner is associativity of actions

Adding one action can lead to several different behaviors



TAKEAWAYS

A PLANNER SHINES WHEN IT MAKES AN INFORMED DECISION

If the NPCs has no information to weigh 2 options, there's a problem

"Random" isn't something a planner likes

TAKEAWAYS

LENGHTY PLANS AREN'T THE END ALL AND BE ALL

Long plans have more chances to fail when executing

Do not use this as an indication of the health of your AI

TAKEAWAYS

BIGGEST HURDLE EARLY ON IS THE GRANULARITY OF KNOWLEDGE, ACTIONS AND GOALS

Define what a goal is and what an action is

Not everything is worth simulating in the planner

TAKEAWAYS

DON’T NEGLECT INVESTMENT IN TOOLS

Difficult to understand why a decision was made

You will want to know why something *didn’t* happen


SHOULD YOU USE
A PLANNER?

SHOULD YOU USE A PLANNER ?

I WANT MY NPCS TO DO VERY SPECIFIC THINGS AT VERY SPECIFIC TIMES!

SHOULD YOU USE A PLANNER ?

OUR GAME IS ALL ABOUT INTERACTIONS BETWEEN SYSTEMS!