A Hockey Manager Game

Steven Duvall

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Contents

1 Introduction

1.1 Purpose

The purpose of this document is to outline and describe the various gameplay elements of **Hockey Manager** as well as artistic and technical elements of Hockey Manager. As someone with primarily a Software Engineering background, this document will serve as a way to communicate various technical ideas and designs clearly to a wider audience.

1.2 Scope

This document is intended to be read by individuals with a diverse knowledge background, and to inform those not working on the project of design decisions and challenges.

2 Target Systems

2.1 Steam/PC

The initial design of Hockey Manager is primarily focused on releasing on Steam for PC. There will be a great deal of information displayed to the player (analytics, statistics, etc.), that will feel intuitive on PC, but cumbersome on console.

2.2 Switch/Consoles

The primary focus of development will be on PC, but console will always remain on the table for a potential release. I personally enjoy having games on the go, so Nintendo Switch would be the most likely to get a console release.

Due to the lack of technical requirements for Hockey Manager, the main obstacle for Switch would primarily be redesigning the UI/UX for console.

3 Development

3.1 Software

Hockey Manager will be developed using the OpenSource game engine Godot. Most, if not all of the code will be in GDScript, with some potential DLLs in C++ for efficiency.

4 Specifications

4.1 Concept

The goal of Hockey Manager is to create a more engaging team manager simulator. Many sport simulation games rely heavily on a players current knowledge of the sport as well as athletes playing that sport. In order to alleviate this problem, the introduction of analytics will drive the player's decisions.

4.2 Story

Hockey Manager will take place in the modern-day with what we consider 'modern-day' hockey. There is no substantial story elements to Hockey Manager.

4.3 Game Structure

The player will interact with the game through extensive UI/UX. A 'main' page will be the primary view of the player which will display the upcoming game their team is playing, as well as various high level analytics for each team in said upcoming game. There will be menu buttons that allow the player to dive into their own team roster to access player stats and analytics, access other team's rosters, seek trades with other teams, replay events in previous games, as well as other general manager decision.

4.4 Player(s)

This will primarily be a single player focused experience with other teams being piloted by a novel AI making decisions based on factors such as difficulty and general analytics. There is potential to add player leagues to allow up to 'X' number of players to control a single team within a single league similar to how fantasy leagues work with professional sports, but this is not a priority.

4.5 Actions

Player actions will almost exclusively be done through UI/UX. Selecting menu items will allow various actions to take place such as advancing the current season (simulating the next game), trading a player on your current roster, changing line combinations, changing individual player strategies, etc.

4.6 Objective

The main objective for the player is to assemble a team of athletes that will perform well enough to gain a position in the playoffs, and then ultimately win each match in the playoffs to win the equivalent of the Stanley Cup. While this is the main objective there will undeniably be seasons in which athlete signings and retirements/trades that will cause the managed team to decline and be unable to stay competitive. In these situations the goal would be to rebuild the team to be competitive once again.

5 Gameplay

5.1 Drafting

Upon starting a new franchise mode, the player will start with a team of randomized athletes to fill an entire Hockey roster. Before any games are simulated, the player will be given the opportunity to draft players that are entering the league. This will give the player the opportunity to view their current roster's strengths and weaknesses and draft players that can either improve aspects of their team, or could be good prospects to develop or trade later on. Drafting will also occur in-between seasons after a team has won the current seasons championship.

5.2 Trading

During the simulated season, at any point in time **before** the trade deadline, which is some weeks before the end of the season, the player will be able to offer athletes on their roster as well as draft picks to other teams in exchange for athletes on their roster or picks they posses. Trades will be evaluated based on various analytics for the athletes involved in the trade. Trades in general will need to have 'equal' value between the two teams. While one team may value a certain player in the trade more than another team (a need for a Left Handed Defensemen for example) the caliber of players need to roughly be equivalent to allow for realistic trading. There will be some exceptions to this though, as 'star' players from other teams will never be accepted in a trade. While the player will be able to trade 'star' players, other teams will likely never trade them.

5.3 Athlete Development

During the season the player will be able to develop specific players during 'training' days they will have separate from 'game' days. This will likely just be assigning players to specific training routines to boost a specific stat (shot accuracy, skating speed, etc.) that will scale based on a hidden 'developing' stat associated with each player. The higher this stat, the greater the potential boost training will give that specific athlete.

5.4 Activating/Deactivating Athletes

The player will have the ability to swap players in and out of their active lineup either due to an injury, or a decline in performance, or a change in strategy. There will likely be a 'minor' league team in which deactivated players will reside until they are either traded, retired, or activated again. Players that are activated will need to fit under the financial cap though.

5.5 Financial Cap

In order to prevent players from just signing and trading for all of the best players in the league, there will be an artificial money cap that a team will not be able to exceed. Generally, the better the player, the more expensive they are. However, there will be exceptions to this by signing rookie players

to entry level deals, or signing players to 'hometown' deals. Players that are injured during the season will not count towards the players cap and will be placed on an injured list. Injured players will not be able to be activated again until there is enough cap space for them (this is generally done by moving their replacement background to the minor league team or to another team).

5.6 Athlete Analysis

A crucial aspect to this game is the player looking through various analytics for players around the league and make general manager moves to improve their team enough to win a championship. There will be menus in which player stats for their career will be available to visualize on graphs, and compare to other players in the league. Various real world stats will be available (shooting %, CORSI, Expected Goals), but the player will also be able to view more advanced analytics such as passing percentage, common passes, ice location bias, pressured players, etc. Considering the games will be simulated, any and all stats will be available to save and display to the player.

5.7 Game Simulation

In order to progress through the season, each game will be simulated against opponent teams. Before each game stats for each team will be displayed and the player will be given the chance to view the opponents stats as well as their projected athlete line up. The player will then get to choose offense and defensive schemes for each of their lines as well as their Power Play and Penalty Kill schemes. The player will also be given the chance to activate/deactivate athletes on their roster, as well as set a goal tender for the game. Once the player chooses to simulate the game, a decision tree simulation will commence to simulate the game playing out. Post game statistics, as well as a 'replay' of the game, will be available once the game is finished simulating.

6 Technical Implementation

6.1 Athlete Generation

One of the most important technical aspects of this game is how the athletes are randomly generated. Simulating athletes poses a couple of problems that need solved. The first of these is determining what stats an athlete will have that will drive their statistical results. Unlike real sports, where the player's skills and development drive the stats, the athletes in this game will need to have a quantitative set of attributes that will cause certain in-game events to occur. Once these are set for an athlete, based on the games they play, and the 'performance' they have, the statistics will be created from their performances. The second issue athlete generation presents is what range of attributes should be allowed. While a potential solution to this would just to assign a percentile to a specific attribute, such as a 95 in Skating (meaning they are in the 95th percentile). However, this would cause potential problems when adding/removing athletes from the league as well as needing to update every athletes attributes. This would be an evolving attribute that in theory could scale indefinitely without proper bounding. A solution to this issue is to scale attributes based off of real-world hockey data.

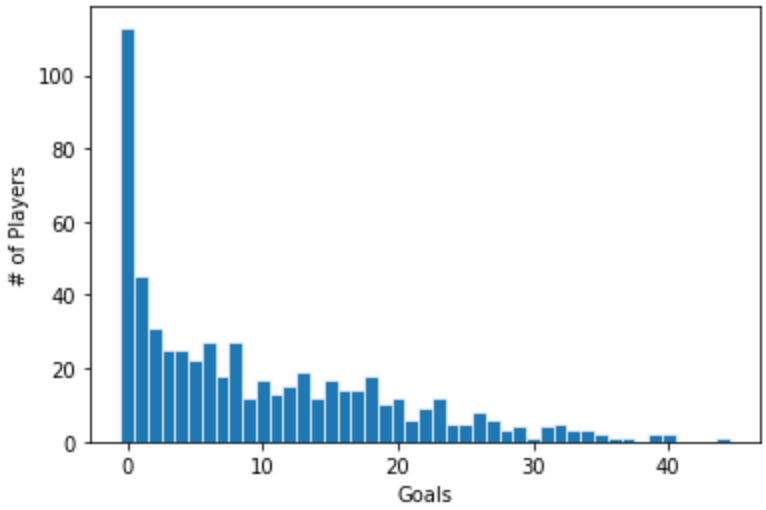

Figure 1: Plot showing the distribution of forwards and the number of goals they scored for the 2016-2017 NHL Season

Referencing the figure above, a mathematical equation can be created to express a relationship between the number of athletes in the league and the number of goals they score throughout the season. This can be used as a weighted distribution for new athletes generated to ensure they fit into the league averages for scoring, but still has room to generate exceptional players outside of the norm. This will need to be tuned to ensure there are still plenty of exciting athletes in the league that players will want to trade for and build their roster around.

It is not a finalized list, but some potential attributes for generated athletes include: Shots on goal, Passing Accuracy, Shot Attempts, Goals (High, Med, Low Danger), Primary Assists, Secondary Assist, Shot Location Bias, Blocked Shots, Take-Aways, Chemistry, Hockey IQ, Development Projection, Conditioning, and 'Superstar'. It is worth noting that some of these attributes are not stat-driving attributes, but rather descriptive of an athletes performance. Work will need to be done refining these.

6.2 Game Simulation

In order to have athlete attributes drive their statistical performance, a way to simulate the result of a game, play-by-play, will need to be created. This will most likely be done by iterating through each 'step' in the simulation, and determining the decision and action of each athlete in that step, and the results of those actions. For example, at the beginning of the game, the puck is dropped at center ice where there are two potential outcomes. Either athlete 'A' will win the faceoff, or athlete 'B' will win the faceoff. Once the faceoff result is determined, each athlete in the game will have a set of rules governing their next move based on the current game state. This will start with the athlete possessing the puck (if there is one), the the athletes on the 'offensive', and then the athletes on the 'defensive'. This order is largely due to offensive players be active and defensive players being reactive. The next step in the simulation will be determining the action each player will take. Continuing with the previous gamestate, the athlete that won the faceoff will need to determine how to move the puck into the offensive zone (the main goal of the current game state). This can be done by skating the puck into the zone, or by passing the puck to another athlete to move into the zone, or by dumping the puck into the zone and chasing after it. This type of execution will continue until a play stoppage or the game ends. Each of these 'events' in the game will have competing head-to-head outcomes that

will be determined by using the Log5 method.

$$\mathcal{P}\alpha, \beta = \frac{\mathcal{P}\alpha \times \mathcal{P}\beta \times (1 - \mathcal{PL})}{(\mathcal{P}\alpha \times \mathcal{P}\beta) - (\mathcal{PL} \times \mathcal{P}\alpha) - (\mathcal{PL} * \mathcal{P}\beta) + \mathcal{PL}} \tag{1}$$

Where $\mathcal{P}\alpha$ is the probability that the outcome of the event will favor athlete α, and $\mathcal{P}\beta$ is the probability that the outcome of the event will favor athlete β. $\mathcal{PL}$ represents the league average of the event outcome favoring an athlete. A method will need to be created to determine a statistical outcome based on the attributes of the two athletes. For example, a forwards has a shot on goal with an shooting attribute of 92, and the goal tender has a save attribute of 89. Generally the outcome should favor the shooter, but only just, so a method will need created to represent this outcome.

In order to implement this type of simulation, a graph data structure will be used to keep track of current athlete locations, the location of the puck, and adjacency lists for various types of play.

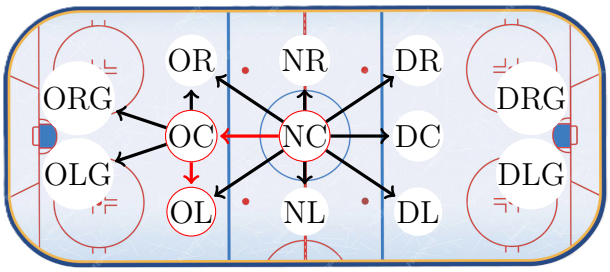

Figure 2: Graph showing Offensive, Neutral, and Defensive zone node locations

In the above figure there is an example of an athletes potential play options if they were to start at center ice in the neutral zone. What is not pictured is how other athlete positions will impact this decision making. Plays towards the offensive zone (for a goal) will be weighted for the team on the offensive, and passing plays will bias towards teammates that are less covered by an opponent athlete. Similarly for passing, shooting will also be biased based off of a clear shooting lane (or congested for redirects), current shooters location on the ice, type of play being executed (redirection, rebound, crashing the net). These plays will also be weighted based on the type of player creating the play. A 'sniper' is more likely to shoot the puck at

a particular location on the ice than pass the puck, and a playmaker is more likely to make a tough pass to an open teammate. There will also be many more nodes in this graph to allow for finer movements and more diversity in plays created.

There will most likely be different 'schemes' for the player to choose from. The player will be able to assign various positions (or even as granular as each athlete) a specific strategy to how they should play. For example, in hockey a defenseman typically plays conservatively to avoid odd-man rushes and breakaway goal chances. However, there are many offensive-oriented defensemen that play more aggressively to open up space for the forward players to gain scoring opportunities. Both of these strategies have their pros and cons and typically succeed based on the type of player playing within those schemes. Allowing the player to choose these schemes on a per position (or athlete) basis will fine tune the different decisions that the athletes AI can make.