DONE:

Re-implement the mission system with the interval tree.

Excess animals should be slaughtered in the fall.

TODO:

Each map tile should contain how much is forested, how many acres can be farmed and how many can only be used for pasture(land unsuitable for farming).

About 25% of the information in the Family struct seems to be related to farming and animal husbandry. It would make sense to move this over to some

other struct that will be allocated for every farmer.

In order to know the quantity of goods they take an assumed measurement, all seeds are assumed to be in ounces and then have to be converted whenever they are needed to be something else. Instead a simple struct that tracks a quantity and uses a flag to declare what measurement the good is using.

To approximate goods that aren't discreetly in the game such as firewood or farming tools or clothing each family should be required to consume x wood or x amount of wool to generate these goods.

PopulateManor has some things like determining which animals and crops to use is hard coded and should be made into a generalized algorithm.

Lua class system should not use strings for class names but integers.

Retinue Events

Lua class system should allow constant objects.

TODO Family:

People should eat once a month instead of every day, if someone dies before the month is up refund the food.

Animals should eat once a month and refund food if they die.

Animals should produce food only once a month instead of calculating how much milk they make per day.

Every day every family checks whether it is march or September, instead of these two checks being in the FamilyThink function they should instead be hard coded into the main think loop, so that the check is done only one per day and then performs the necessary code on each family.

Currently each person is fed one days worth of food per day. However this should only work when they have sufficient food. When the family doesn't have enough food for the rest of the year they should start eating 3/4 or 1/2 rations instead. Furthermore once they have enough food they should start to eat extra to gain back the nutrition that was previously lost.

Every month each family should calculate how much food they have left. If the family has something like only one month left or not enough food until they harvest their fields (What about non farmers?) then a starving family event should be pushed. The mission system should then have several events in place such as them asking the leader to give them food or stealing it from other families, or the family just packing up and leaving. Asking food from the leader could give the leader a small popularity bonus.

Notes:

Big guys currently do a lot more extra than regular people. They have their own AI, opinions of other big guys, their own personality, traits, and their own stats. For some sections of the game that have not been done yet such as officials it would seem you would need a large amount of big guys to fulfill every position. However the idea of a big guy is someone who is not content with their current position and wants to advance their position. This is why they are given a more advanced AI, so they are able to stand up against the player and to be able to do complicated actions to achieve their desires. It would seem that a third classification of person is needed, one that has stats, and perhaps opinions and personality that represents important people who are content with their current position.

Can big guys be renamed to character? In RPGs the important people are called characters which is essentially what a big guy is.

Tech Tree:

The tech tree will have three different categories, economy, law, and military. Economy will revolve around raising taxes, tax efficiency, the size of buildings, building special civic buildings, and improved arms and weapons. Law represents stability and diplomacy affecting how many alliance you can have, which types of governments you can use and special laws that change your settlement. Military unlocks different tactics that can be used in battles, army management such as army size and logistics, and increases the skills of your army.

Each tree has its own specific points that can be used to only buy techs from that tree. All three trees have a different way to gain points. The economy tree gains x points per year based on how many civic buildings you have and how well your craftsmen are doing. Your craftsmen are considered to be doing well if there are a certain amount of them. Law gains points based on how many alliances you have and the tier of your government. Military tech points are increased by having battles and the size of the battles.

Civic buildings

Town hall – Allows officials

Granary - Should allow starving families th ability to take food from it. (Should this always be done?)

Palisade - Helps protect from raiders.

Big Guys:

Big guys are specialized people who are intended to represent ambitious/scheming people, and are also considered the potential opponents of the player. While regular people have a simplistic AI the big guys are given a specialized AI that allows them to complete complex tasks that will allow them to achieve their goals.

Retinues:

Retinues are intended to be your force pool before you can fully utilize the fyrd. They also will be loyal to you and will help you with plots and other trouble. Retinue's are consisted of family members and warriors who have come to join you. Originally the idea was to pay upkeep with food but with how scarce food now is it would seem impossible to have a retinue over one person if any at all. Instead a warlord must equip his retinue with weapons, give them spoils of war, and to assist them in plots and events. Once the person who is part of the retinue dies he will give the war band leader his equipment back. To make this happen metal weapons should be rare and usually obtained through taking them from other people or from battles. A non-metal weapon should be created for people who cant obtain a metal weapon.

The frequency that warriors will come to join your retinue will be based on how much glory you have. Each month you will have a chance to attract “freelance” warriors to your retinue based on your glory. If your glory isn't high enough you will instead have a chance to have warriors leave your retinue.

Every warrior that is not currently in a retinue is considered as a freelancer. Whenever a retinue looses a warrior they are put into a pool containing all freelance warriors, and whenever you gain a warrior you take them from this pool. When a warrior is in the freelance pool and is recruited by a retinue in a different village they will instantly move to the new village.

Stats:

Stats are designed to be a way to represent how good big guys are at various different tasks. Currently with the exception of intrigue and the combat stat the stats are very similar to dnd stats. Stats are on a 1-100 scale with the average being in the 70's and the highs in the 90's.

Plots:

Plots I think is actually a bad name to represent the idea as it could also be conveyed as a feud. A plot is an action a specific big guy is taking against another big guy. In order for this action to be taken they must first win the plot. To win the plot one of the sides must have x more points then the other side, where x is dependent on how many people the other side has. Each side can enlist other big guys and little guys to help their side of the plot to either defend against the action or to help it succeed.

All big guys can select a special action to perform that has properties intended to help their side. By choosing to perform a special action the actor's side's threat will increase by a certain amount specified by the action taken. All actions additionally have a percentage to succeed based on the skill the action is using. The actions are separated into three groups, combat, intrigue, and charisma. Combat is intended to score a lot of points but increases threat rapidly. Intrigue is about manipulating the opponent to impede their efforts. Charisma is intended to help protect your side from loosing points.

Once one side has won the plot the amount of threat is tallied up. The winner of the plot has three options to choose to do nothing to the opposing leader, to increase the winner's threat by 15 to banish the opposing leader, or to kill the opposing leader for 30 threat. Additionally the leader of the side that has the most threat will loose a percentage of their popularity based on the difference between the two side's threat levels. This means that if you use a lot of threat but loose the plot the opposing side will be allowed to banish or to kill you for no popularity loss if you have 15 or 30 threat more than them as the formula for popularity loss is

|HigherThreat - LowerThreat|.

Popularity:

Simple percent of how many people like you. Naturally degrades over time. Charisma multiplies any increase and lowers any decrease to your popularity. Formula to use for this is (log(x) / log(2)) / (log(100)/log(2)). To avoid a lot of calculations a lookup table for all charisma values between 1 and 100 will be created. Using this formula a person with a charisma of 90 will have about a 5% advantage over a person with 70 charisma. The difference is very small so I'm unsure if this should be implemented. AI should use popularity to help determine the utility of joining a plot.

Ways to increase popularity:

Hosting feasts - costs food which is very scarce.

Raiding - Causes causalities.

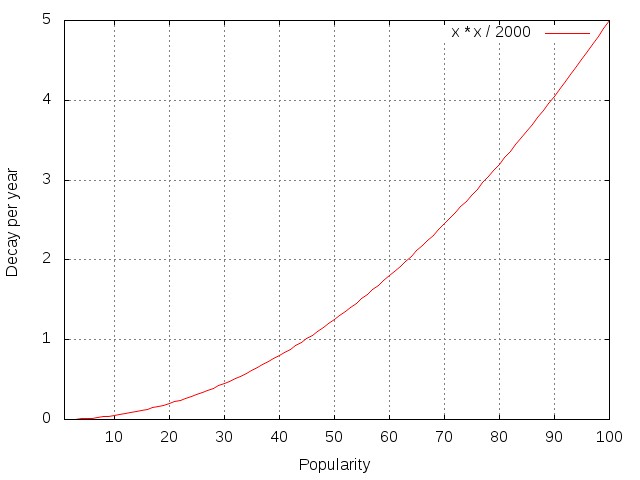
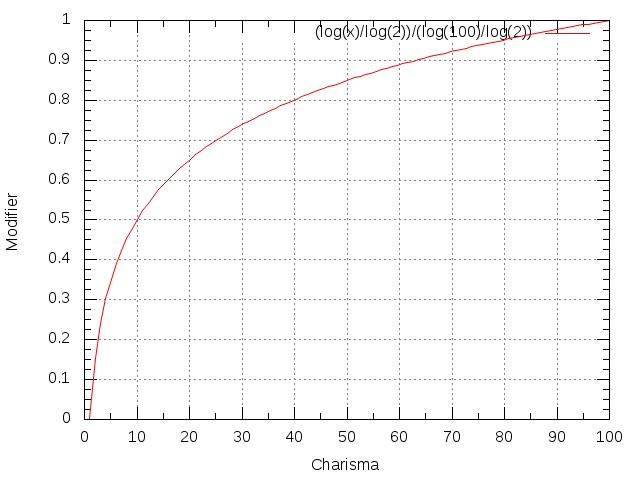
Justice - Lowers relations with law breaker.

Events - Deciding to help people in specific events.

Ways to decrease popularity:

Sabotage Plot - Lowers relations with target.

Events - Result of some specific events.



Castes:

The point of the caste system is to give certain families predefined behaviors based on their caste. Slaves would behave different than people in other castes because they would generally have to do other people's work while receiving little of the benefits of the work. Furthermore they wouldn't be allowed to make decisions like if they wanted to buy animals or goods because the family that owns them would make those decisions for them.

Currently the castes are slave, low class high class, and nobility. Each of the castes has a list of goods that they demand. The goods that they demand are split into two groups, essentials and luxury. Essentials are goods that are required to survive such as foods, lumber, clothing, etc while luxury goods obviously are only bought if the family's essentials are met.

Castes are designed to determine the role a person has in society which effects the jobs they are allowed to have. The four different castes are slaves, peasants, craftsmen, and nobility. Slaves are unable to pick their job and instead help their owner out in their duty. Peasants primarily produce food but in the absence of craftsmen can also produce simple goods like clothing. Craftsmen can produce complex goods such as goods requiring metals. Finally the nobility are allowed to control settlements, become officials, etc.

Combat:

I plan on redoing the combat system to be more simplistic. Instead of what I have now I intend to use the phase system(skirmish, melee, retreat) and the three fronts (left, center, and right) as well as a reserve front. Instead of having increasing stats like originally intended they will not increase as the game progresses. In addition to the current stats all big guys have they will also have four more stats, combat, impact, quality, and armor. combat is a number that represents how well the warrior does in when doing ranged attacks or regular attacks. Impact is a number that represents how efficient the warrior is in a charge. Quality represents how well trained the warrior is and gives a multiplier to their stats as well as reduces moral loss. Armor can be unprotected, lightly protected, protected, and armored.

Combat will have several different types of units which will be dynamically determined these units are skirmishers, light infantry, heavy infantry, and calvary. A unit will be determined to be a skirmisher if they use a ranged weapon and a light melee weapon. Light infantry are warriors with an armor rating of unprotected or lightly protected and have a melee weapon and shield. Heavy infantry likewise are the same as light infantry but with protected armor. Calvary is any warrior that is equipped with a horse. Each unit type will gain bonuses based on the kit that is given to them. Light and heavy infantry when given javelins will never use them as a ranged weapon but will instead gain a bonus when receiving a charge. Likewise using a spear or sword gives you an advantage in melee while using a seax or light spear do not.

Currently warriors are grouped into a war band based on their settlement. As a settlement can produce both infantry and heavy infantry the stats of the war band are recalculated as warriors die to take into account that there are likely few warriors that greatly impact the war band's stats. To simplify this a settlement will produce a war band for each type of unit type it produces and then assumes they are all the same of very similar.

Each war band will also have a moral stat that can either be unbroken, wavering. When a war band is unbroken they fight with no modifiers. A wavering war band will receive a negative modifier to all combat rolls. When a war band is broken they will take additional damage for the round they were broken in and then sent to the reserve front where they will be unable to be sent to another front unless their moral is improved.

All units start in the reserve front where they are able to receive damage but unable to deal any damage. Any reserve unit can additionally move to any of the three fronts though only skirmish units can participate in the skirmish phase. The skirmish phase can end in three different ways, one side wins and forces the opponent to charge the winner's infantry, one side wins and the opponent does not charge and the skirmishes expend their ammunition, or one side initiates the melee phase. When the melee phase begins and skirmisher that is not also counted as infantry are sent to the reserve front and the side charging receives their impact bonus.

After each round any infantry in the reserve front can be sent to one of the three fronts. Every war band in each of the fronts will do a moral calculation and determine the new moral status for every war band. Once one side wins a front they are able to attack an adjacent front with a bonus.

When one side no longer has any men to field due to casualties or moral loss the phase will change from melee to retreat. In this phase the side that has won the melee phase will get a combat bonus for several rounds until the fight is decided to be concluded.

Contrary to most games warfare in Herald will not allow the player to directly control their armies. Instead the player will give their armies goals to which their army's leaders will attempt to achieve to the best of their ability. In the beginning only very abstract goals will be allowed to be given to your leader's limiting their effectiveness. As your tech increases the goals will become more specific allowing greater control over their actions. While the player does not have control over

their armies directly they still play an important part in military affairs.

As in Crusader Kings 2 there will be a list of tactics that generals will be able to use. Tactics will be able to improve units during specific phases, increase the attack or defense of units, give bonuses to fighting certain fronts(center vs left/right), and other various advantages. Tactics can also give only negatives which will be chosen by bad generals or occasionally by a general with a bad personality The high level a general is the more tactics a general can learn as well as the better the tactics are. When a general is of a sufficiently low level their tactics will actually give negative attributes as opposed to positive ones. As each big guy is intended to have a personality, the personality of the general will also determine which tactics they choose. The differences in the personalities of generals will help ensure that no one general is the best and encourage to have several good generals than one great general and many bad ones.

The combat system while cool might be to complex as it would take a lot of work to implement different types of commanders, stats, detecting what unit type a warrior is etc. As such this will be done iteratively with the idea that some of the above ideas might not be in the game due to the time it would take to make it.

Agriculture:

Agriculture is one of the most important aspects of the game as it reflects the amount of people a kingdom is able to sustain and thus the strength of the kingdom. Agriculture will a constant problem as semi-frequent famines will force the player to either trade or raid for food. While important the agriculture of a kingdom will not be able to be directly managed as it would be considered to tedious to manage. Instead the game will determine approximately how many people in a village should be farmers and then the AI of that family will then farm and/or raise animals.

To determine how successful the yearly harvest will be each year a random number between 0 and 9 will be generated that will be added to the previous 2 year's roll, the sum of these three numbers will represent a multiplier each farmer will get on their harvest. This multiplier will be between 0.5 and 1.5 inclusive. In order for someone to farm they require three things; land to farm, farming tools, and seeds. Once these conditions are met any person who's profession is a farmer will begin to farm their fields, and if they lack one of these will attempt to obtain them.

Once a field is planted the amount of time it takes for it to be harvested is based on the temperature of each day. Fields in cooler locations will generally take longer to grow and thus more work, while warmer locations will have their crops grow faster.

When the family's crops have grown they will begin to harvest them. Once they are all harvested the crops can be turned into one of two things. The first is into slow spoiling food that can be eaten by anyone for nutrition or traded. The second is as a good to be traded. The good can then be sold to someone else for a profit based on that crop's trade good value. The game will only turn crops into trade goods if it considers the family to have sufficient food for themselves until their next harvest. The goods can then be sold at a price that is based on a multiplier each crop has.

Animals:

Animals are used by farmers primarily for meat, diary, and to help plough fields. Each animal is modeled individually and have their age, gender, and nutrition amount tracked. Each animal type also contains basic information that each animal uses such as how much meat they produce when slaughtered, how much milk they give, how many babies a mother can have per year, etc.

Trade:

Professions:

Every profession has a list of goods that it is allowed to create. Any other good that is not on the list must be bought at the market. Initially every family is the farmer profession, the game will then decide which family to upgrade and what profession they should become. To determine this the game will first decide if the settlement can support a person who is not growing their own food. If the settlement is the game will then determine which person will be selected. The person selected will be a son of a farmer who is considered an adult but has not married, or a family who are farmers but own no land. Finally each profession will declare to the game how important it is, the game will give the professions of descending importance.

The farmer profession is a special class that will produce the goods that it demands if none are being sold, the family cannot afford to buy the good, and it is possible to produce it (cannot make timber without trees). Farmers should be considered inferior in producing any good that does not directly result from farming or animal husbandry than another profession that produces that good.

Each family that has a profession will also have skill rating. The four different skill ratings are, adept, competent, skilled and master. The family doesn't retain any experience points but rather each family is assigned a skill rating based on how many of that profession the settlement has. Thus the more of each profession a settlement has the more they will be skilled.

Profession Idea:

For each master you have in a level gains you experience that can be used to unlock upgrades for that profession. For example a master farmer might contribute xp that could then allow better farming techniques to raise the yield of crops. A master blacksmith would be able to lower the time to make goods, or to increase their quality. By specializing in specific professions you would then gain an excess amount of these xp points and then have an edge over opponents in that area.

Government:

Government is responsible for determining who is in charge of a village or group of villages, how ruler succession is determined, and which reforms have been enacted. Governments work in a hierarchy allowing smaller governments to be owned by larger governments. How smaller governments are controlled is dependent on its controlling government.

What happens when the current ruler of a government dies is also controlled by this system. Governments have three main ways to determine the next ruler which are elective, monarchy, and elective monarchy. Each election type also can be modified to allow only specific people to be eligible for becoming the new ruler, such as female only or male only for a monarchy government.

Reforms change how the government acts by allowing more control over the nation by allowing the ruler to take levies and taxes from its vassals. Reforms can also control the privilege that vassals of a nation have as well as what the ruler of a nation can do. In the beginning of the game a tribal nation with no reforms will be unable to even control other countries, and are only able to force tribute from them instead. Specific reforms will allow these tribes to begin to vassalize their

neighbors and to change their government form.

In order to pass a reform several prerequisites must be met first. The primary prerequisite is to have specific reforms already passed. The next most common prerequisite is to have a certain amount of authority or prestige that will be spent when passing the reform. Once you fulfill these prerequisites the reform will for most government types need to be approved by a body of people, where you will need a majority vote to pass the reform. People in this body who like you will automatically vote for you. However for people who do not like you will have to be given concessions. Concessions can be for things like land, tax breaks, and other ways to increase their own power or authority. If you are unable to pass the reform in a certain amount of time due to lack of support you will loose

the spent resources used to start passing the reform.

Along with different election types, government structure can also be customized in two ways. The first determines how the government is run and by who. Governments can be controlled in as an absolute government giving total control to the ruler, or as a republic allowing multiple people to share the power of the nation. The second way is how the nation is structured, such as a feudal, tribal, or a confederacy, etc. How the government is structured will give the nation different advantages and disadvantages. The structure will also allow different reforms to be passed.

Bulletin:

The bulletin is an idea that I like a lot but was created to solve a problem that didn't exist yet. The bulletin should list of what could be considered quests. For example a game event could fire that declares someone stole from a big guy, this event would then create an item on the bulletin. The player could then decide to either help the person or not, while not having frequent pop up menu's of random people asking for their help. In this example if the player decided to help find out who stole from the big guy would make several decisions which the success of these decisions would depend on certain stats of the player. Generally the difference between if something should be a game event of put on the bulletin is if you will get a penalty for rejecting to help the target.

Officials:

Every leader should have a certain amount of "power" that they are able to wield. This power is similar to the demesne count in Crusader Kings 2 where it is a fixed amount that you are able to spend to have control over certain parts of the government. For example, it would require power to personally ensure that everyone is following the law, or to personally collect taxes. Personally overseeing these effects allows you to decide if you want to give anyone special treatment such as your friends or enemies while if you delegate your subordinate might use this power for their own means. When you are acting as an official you use one more more of your stats to determine how effective you are at the position. This makes it wise to not try to grab as many positions as possible as your low stats would directly harm the efficiency of your realm.

While you are able to go over your power limit you will see adverse affects depending on how over your power level you are. To use the two previous examples again someone might not pay any taxes or might be able to break the law if you try to wield to much power as you are to busy doing other work. This will have additional effects of big guys having lower opinion of you if they are effected by lawlessness and your popularity will start to drop.

In the beginning of the game every person will have little power and will be unable to directly or possibly even semi-directly control a medium sized kingdom. As the game progresses each person will be able to control more and more power representing increased centralization. Additional positions will also be unlocked allowing you to increase how many officials you have and the efficiency of your realm.

As with other systems the types of officials will be split up into three different categories, economic, law, and military.

Taxman: responsible for gathering taxes from other settlements.

To lower the amount of power that the player is required to have he can appoint officials to the three groups of power. By doing so he will be giving an AI the ability to control that section of his government. For example by appointing military officials the player would loose out on directly controlling what his army does and instead have an AI that decides where and when to attack in war. As the official is a different person than the player they will use their own stats in determining how good they are at their position which could be useful if the player has a bad ruler.

Game Events:

Game events are structured similarly to how the events in the Clausewitz engine work. In a nut shell they have a mean time that represents roughly how often the event will trigger and they have a condition that will be checked before the game event is triggered. Each day every big guy will check against every single event with a mean time. To help spread this up some of the trigger conditions will be optimized by using an interval tree or something like a Rb tree to ensure that a lot of events get discarded quickly. If the condition is true then a random number will be generated that if it is lower then the event's MeanPercent parameter the event will fire.

Some events will cover things like assaults, murder, theft, etc. However game events only target big guys, which would then mean only big guys are capable of performing these actions. It would be beneficial for little guys to be able to perform these events to as the rate of stealing, murdering, etc would be based on how many people are in a settlement and not how many big guys are in the settlement.

In order to allow little guys to fire these events each event will have a special marker that will declare if a little guy can fire it or not. These special events will not create a pop-up as if they did the player would be swamped with decisions about unimportant people. In above example whenever a big guy breaks the law the ruler will get a decision about what to do with them, such as special treatment, punish them more harshly, etc. When a little guy does one of these actions instead a count of how many laws the little people have committed in the current month will increment. It will be up to a law based official to ensure everyone who broke the law gets punished.

Game events also allow text replacement in their description field. For example by adding the text “[Owner.FirstName]” will be replaced with the first name of the big guy who fired the trigger. These text replacements have a simple syntax similar to an object oriented language which is [Object.Function].

Artificial Intelligence:

The AI works primary through a state machine that only has 2 states. One state contains a GOAP implementation that will fire when a GOAP actions has been found that can be executed. The other state is a fall back that ensures that the AI is not sitting doing nothing but instead is performing actions that would benefit the AI such as joining plots that it would see as beneficial to it.

The core of the GOAP architecture is the GOAP goals and the GOAP actions. The goals contain a utility function to decide which goal to select and a set of GOAP actions that can be fired.

Combar AI: