Tuesday 4th April, 2023, No 6

Good Thought This Thought

Your weekly newsletter

Sixth Newsletter - More in depth!

In this issue, more trains and stocks. This newsletter may as well be a train and stocks explainer at this point. And the articles are long, with the longest being a whopping 3 pages. Enjoy!

Cars Suck

by Based Truepill Taker Milo

People seem to love cars. And they are cool I guess. But why are they so damn large? They infest the city. Without cars, we wouldn't need traffic lights or even sidewalks. And for what do we have 'em? You'll hardly ever use that much capacity, mostly driving it alone. Just get a cheap small thing, and rent a van if you really need it. Or even better, get a cargo bike and invest in proper infrastructure and alternatives to cars. And let the driving be done by the professionals. Life will be more pleasant. All hail the good traffic engineers.

This Week's content:

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Explainer: Who determines the stock price?

by GRILLO, M.

As we know from the first edition of this newsletter, stocks do thing. They have been doing things for a long time, and they will likely continue to do things. But what determines what they do? Who decides their price?

Supply and Demand

Just as with all free flowing products, the law supply and demand apply. If supply is low and demand is high, we have high prices. If the reverse, we have low prices. The supply and demand of a stock may be related to the performance of the underlying business, as businesses may pay out a share of the profit to the stock owners in form of dividends, the stock price and the company performance are essentially **two distinct** things. So how are supply and demand matched? There are many mechanism to do this (e.g. auctioneering), but the stock market works with the Limit Order Book.

The Limit Order Book

A Limit Order Book (LOB) is an electronic system used in financial markets to facilitate the trading of securities such as stocks, futures, and options. It maintains a real-time record of all outstanding buy and sell orders for a particular security, along with their corresponding prices and volumes.

In a LOB, traders can submit orders to buy or sell a security at a specific price. These orders are classified into two categories: limit orders and market orders. A limit order is an order to buy or sell a security at a specific price or better, while a market order is an order to buy or sell a security at the best available price. Limit orders to buy are called bid order, and limit orders to sell are called ask orders (or offer orders).

In the above figure, we can see an example of a LOB. In this example, we can see that there are 200 stock offered to be sold at a price of 100.01 USD. Note that LOB has no one fixed price. Usually, the price quoted as the price of a stock is the average between the best offer and the best bid. Of course this is arbitrary, and you can choose to say the price is some cleverly weighted average of the LOB, or perhaps just the last price at which something has actually been sold. But usually, people just take the unweighted average between the best bid and best ask price.

When a limit order is submitted, it is added to the LOB at the specified price level. If a matching order is found at that price level, i.e. one bid and one ask exist at the same price level, the two orders are executed and the trade

is completed. If there are no matching orders at the specified price level, the order remains in the LOB until a matching order is found, or the order is canceled by the trader. Note that in order to change the stock price, no actual trades have to take place. If the entire best bid layer decides to cancel their outstanding orders, the best bid layer moves to the next layer, and the stock price goes down. Not a single trade was executed, but the price changed nonetheless!

But one can also change the stock price by making trades. If one places a large enough market order, one can 'eat' the best layer. But this is usually expensive. In the above example, to make the best ask move from 100.00 USD to 100.01 USD, one needs to spend $175 \times 100.00 = 17,500.00$ USD!

The LOB is designed to provide transparency and liquidity in financial markets. It allows traders to see the current bid and ask prices, along with the volumes of buy and sell orders at each price level. As the volume is visible, you can have a good idea on the supply and demand. If the total bid volume is much higher, there is a high demand, and if the total ask volume is high, there is much supply. These notions of demand and supply can give you some predictive power over the stock price. The LOB information is used to make informed trading decisions and to ensure that trades are executed at fair prices.

The LOB also uses algorithms to match buy and sell orders based on predetermined rules. For example, the LOB may prioritize orders based on the time they were submitted, the price of the order, or the volume of the order. This ensures that trades are executed in a fair and efficient manner.

Overall, the LOB plays a critical role in financial markets by providing transparency, liquidity, and fair pricing. It allows traders to participate in the market with confidence and helps to ensure that trades are executed in a timely and efficient manner.

Do you know how to fill up this part of the page? Let me know!

Good Poem This Poem

by MLÖ

In the corner of the room,
Lies a kadaver, all in gloom,
Its body stiff, its skin so pale,
Its presence here, a sad detail.

Once a living, breathing thing,
Now just bones and flesh, no spring,
Its journey on this earth now done,
Its soul departed, its race now run.

Yet, in the darkness of the night,
Something strange, not quite right,
A noise, a rustle, a sound so odd,
As if the kadaver moves and nods.

And then, a sudden, loud fart sound,
A smell so bad, it hits the ground,
The kadaver's corpse, just passed gas,
And with it, brought life back at last.

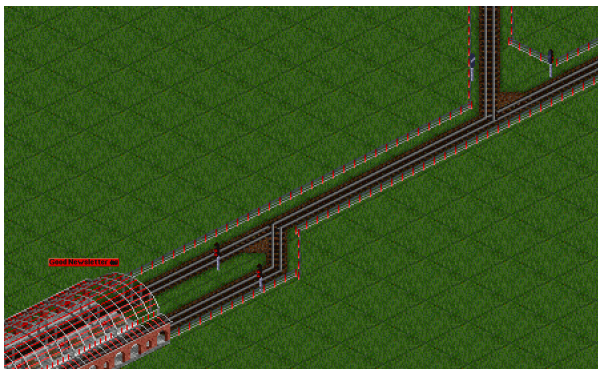
The stench, so foul, it fills the air,
The kadaver rises up, to our despair,
But then, a laugh, a chuckle so grand,
For the kadaver's gas, was its last stand.

Trains: Switches and Signals

by MILO GRILLO

OpenTTD: The Game That Lets You Build and Manage Your Own Transportation Empire.

What mysteries lie in the stars? What is love? Where does life come from? How do you properly organise train tracks? Who of us has never wondered about those big life questions? Although we cannot answer everything, in this article we will at least attempt to answer the last and largest question: how to train tracks.



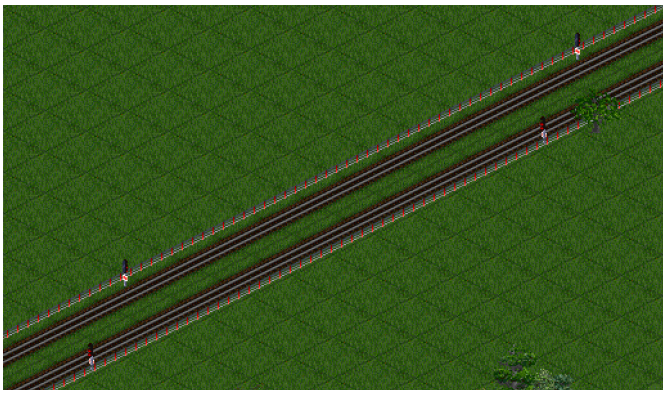
Configuring signals for two lines which share a short track.

Signals

As soon as more than one train enters your network, you should use signals. They allow trains to know when a section of track is clear and when they need to stop and wait for other trains to pass. When a train moves from A to B, it will claim the entire rail section between A and B, not allowing any other train to use it, and in claiming paths, it is first come first serve. But a train cannot claim a track behind a signal. This means that signals are great to when two trains need to cross paths, or when you want to trains to drive in the same direction on the same track. It gives you an additional control over the trains and well placed signals improve the time efficiency immensely. However, one risk with signals is that if they are poorly placed, trains will wait for a free path forever. Therefore one should always be careful placing too many signals, in particular *after* a crossing. Make sure that the entire length of the train fits behind a signal, and that the train does not block tracks unnecessarily if it is waiting for a signal.

Two way paths

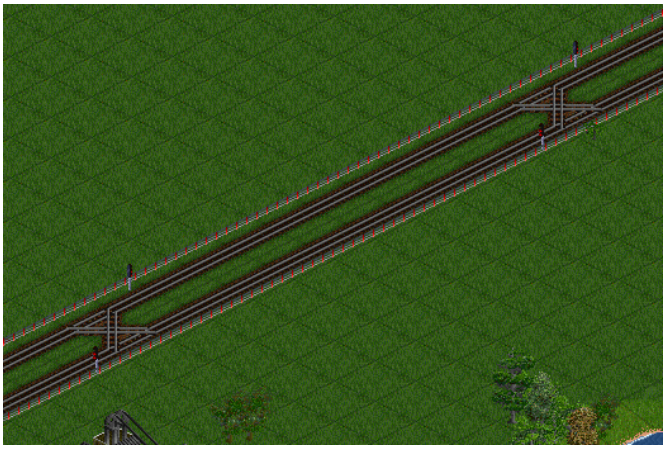
When you decide to build double track, you can make them unidirectional. This can be done using the one-way-path signal. This is a signal which trains can only pass in the direction of the signal. They cannot be passed from the backside. Place one-way-path signals on each track in opposite direction. One per track should do, but if you choose to place more than one signal per track, make sure the distance between the signals is slightly larger than your largest trains. You do not run the risk of trains being permanently blocked by each other.



Two one-way paths in opposite direction.

However, if a train breaks down, a train can temporarily block another train behind it. The other train has no way to pass it. In low traffic places, this should not be an issue, particularly if you have placed multiple signals per track, as the distances between trains is large, but with high traffic volumes, it can add up quickly, and you'd ideally let them pass. Without adding a third rail, this can be achieved as can be seen below. Note that the signals used are not one-way signals, but regular signals. Make sure you place the switches far away from each

other. The distance should be at least longer than the longest train you have, to make sure trains won't block two tracks simultaneously. However, if the tracks are placed too far away from each other, it beats the purpose of the switches.



Two way path with passing.

This solution is great for high volume traffic. For low volume traffic, it does have a flaw, namely that if two trains are traveling in the same direction, without a third train traveling in the opposite direction, the two trains can wait for each other, as they try to overtake each other by passing though the left side and claiming some rail in front. So always choose a design appropriate to your situation! Another piece of advice is to stay consistent with the direction. This holds true regardless of whether we allow passing. In these examples, trains are expected to drive on the right track from their perspective. By keeping this consistent throughout, you will reduce the risk of accidentally creating problems.

Stations

As soon as you have got more than two trains running on the same tracks, it is best to build stations with three (or more) tracks. An example on how to do that can be seen below. By having more than two tracks, you can reserve one lane per direction using one-way-path signals, and have all other tracks be available in either direction. This is particularly useful if the inflow of trains is fluctuating. The station switches can be placed either close to the station, or at least one train distance away from the station. Both examples can be seen in the below example.

Basic station on a two way bidirection track.

An additional tip: make sure your stations are at least as long as the longest train you plan to have arrive and hold there. Trains arriving on too short stations take significantly longer to load and unload, and if the switches are built closely to the station, long trains risk blocking the path of other trains! It is better to build stations too large than too small, and in particular if stations are build close to cities, it can be tough to extend the station later. Build with the future in mind.

More than two tracks

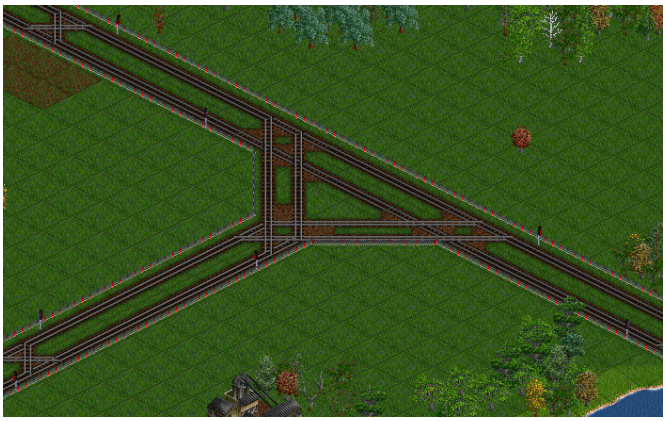
In case of a busy network, you can choose to build three or more tracks. If you do this, reserve the outer tracks for each directions, and the middle tracks can be bidirectional. This is very similar to the train station. By doing this, you ensure there is always a path available, regardless of how busy the network is, and if done properly, trains should never get stuck. It combines the benefit of two unidirectional tracks and two bidirectional tracks, but at the cost of an additional track. An example of the implementation can be seen below. Again, make sure the distance between switches is at least longer than your longest train. If you use four or more tracks, you can choose to reserve two tracks per direction, or only one, up to your wish. The exact ideal length of the switches follows a complicated formula, but as a rule of thumb, you

can make them equal to the number of bidirectional paths.[1]

Three tracks with passing.

Crossings and Forks

In case paths diverge, switches and signals are very important. Below you can see an example of a fork in the road of a high traffic location, so where we have passing allowed. The corners are taken wider than necessary, but this serves a purpose. Trains will slow down significantly when taking tight corners. If we had made the corners tight, we would need less space, but trains will slow down significantly, making them spend a lot of time in the crossing, and potentially blocking the path for other trains. If you can afford wider turns, it is absolutely worth it for that increased efficiency. In particular with faster trains this becomes vital. It takes a MagLev a handsome amount of time to reach its maximum speed, and it would be a shame to slow that metal beast down in a tight turn.



Fork in the road of two tracks with passing allowed.

If we had built the same crossing, but in a low traffic location, we would replace the signals for one-way-path signals, and we would only connect the right lane with each other right lane, and the left lane, with each other left lane. The crossing would still use the same amount of area.

And so much more

There are many more cases to be discussed, such as overpasses, bridges, 4 or more track specifications, crosses where different track widths meet, converging or diverging tracks, (mid-network) terminal stations, clever tunneling, and more. Filling these three pages was extremely easy; I honestly feel like I have tuned it down a bit. I could unironically fill a book with all the different possible designs. Is there anything in particular you would like to see? Let me know!

[1] The number of the unidirectional paths per direction minus one plus the number of bidirectional paths is more exact. In case of the amount of unidirectional paths depending on the direction, the switch lengths are dependent on the direction as well. In that case, the formula for switch length is amount of unidirectional tracks in that direction minus one plus the amount of bidirectional tracks. I found a beautiful and elegant proof of this formula, but it is too long to fit in this footnote.

Good Picture This Picture

by FRANK "*Timon*" DE VELD

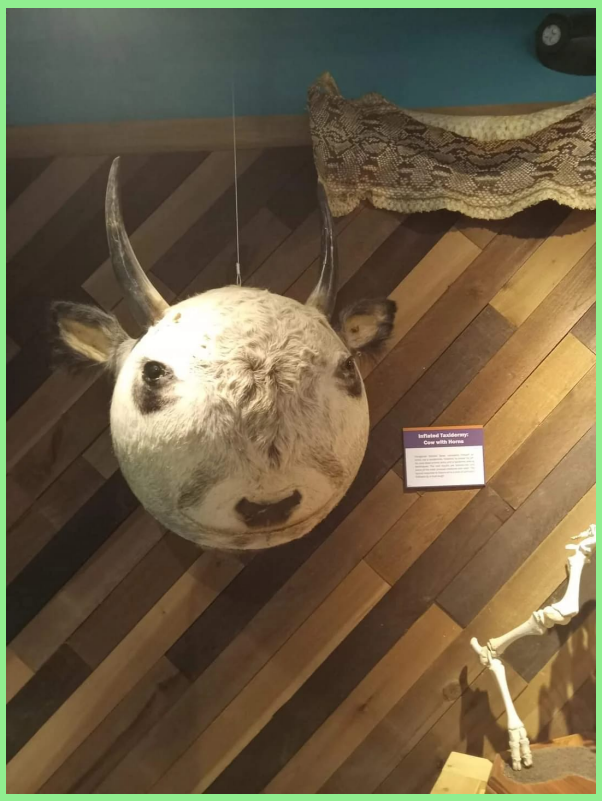


Photo of the Week: The spherical assumption is not violated.

Do you want a chance to get the photo of the week? Send in your suggestion to ✉milogrillo@hotmail.com with 'Good Picture This Picture' in the mail title.