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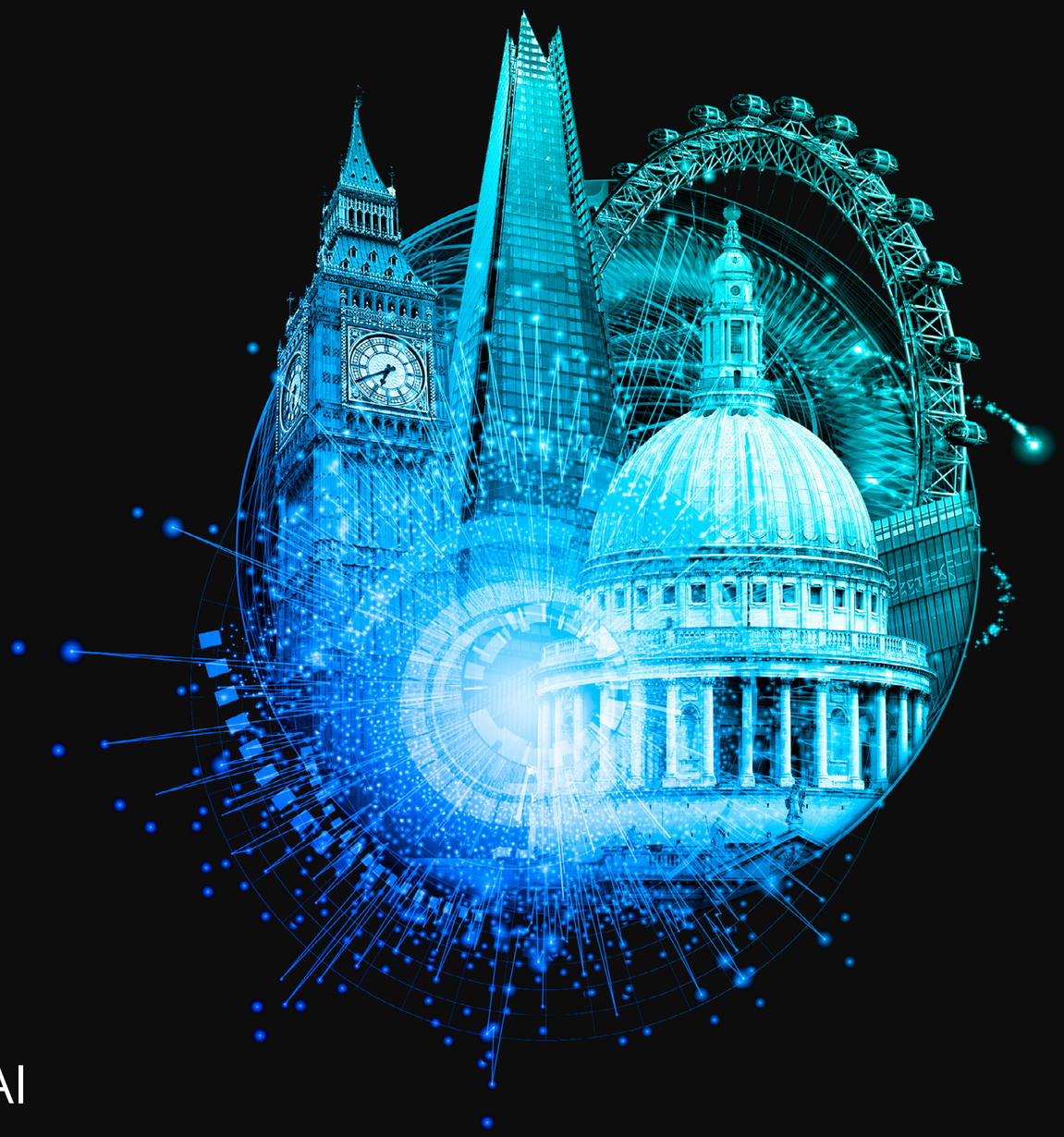
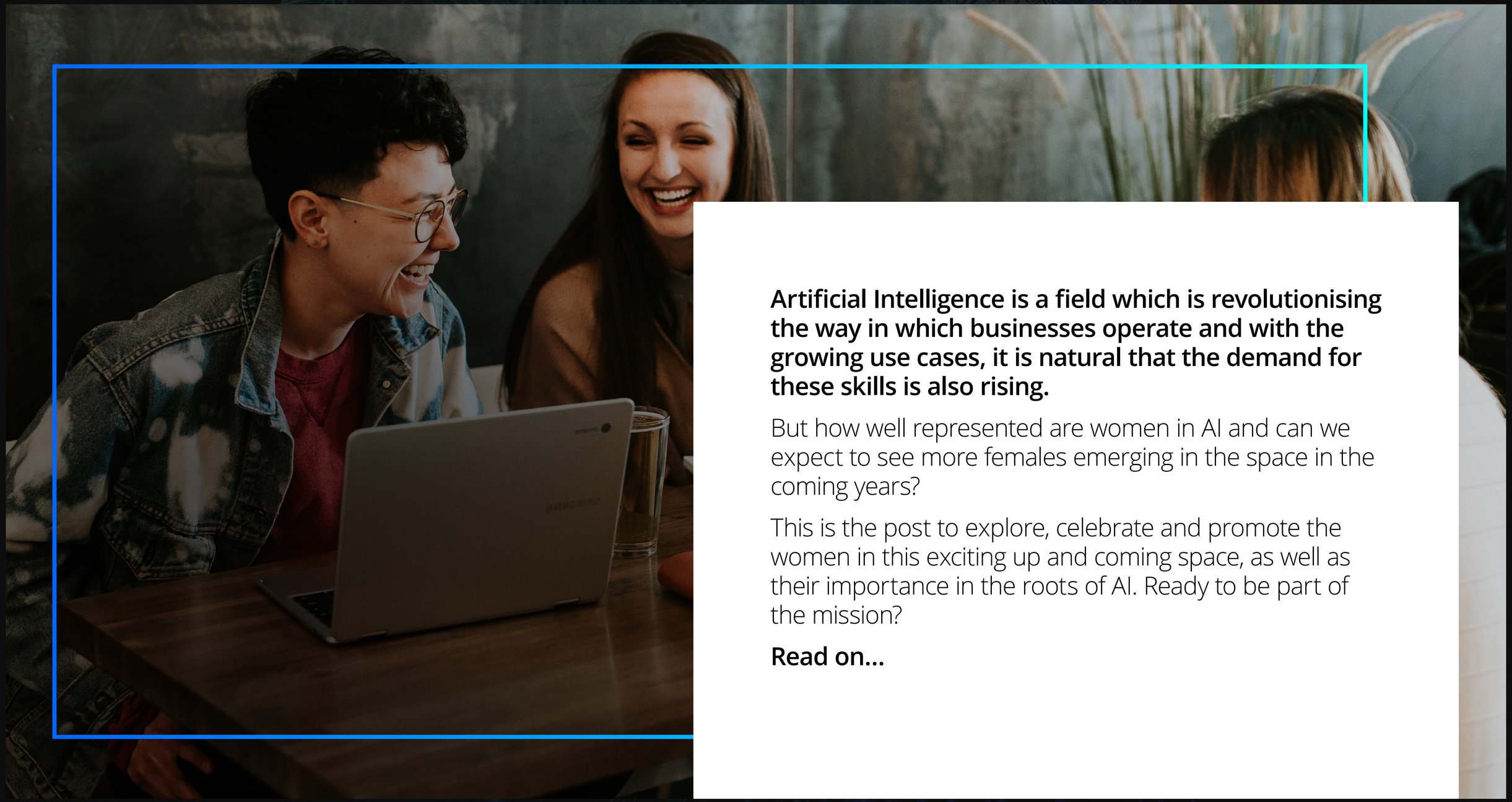


Deloitte AI Institute

History of women in AI

December 2022

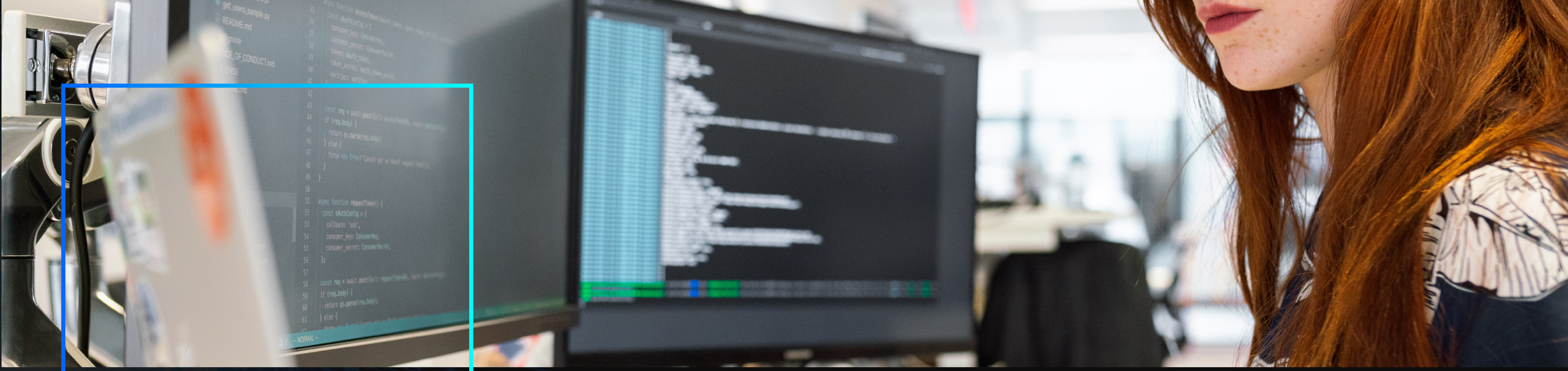


Artificial Intelligence is a field which is revolutionising the way in which businesses operate and with the growing use cases, it is natural that the demand for these skills is also rising.

But how well represented are women in AI and can we expect to see more females emerging in the space in the coming years?

This is the post to explore, celebrate and promote the women in this exciting up and coming space, as well as their importance in the roots of AI. Ready to be part of the mission?

Read on...



What does the current data say?

Historical datasets surrounding the number of women in AI can be hard to find, making it difficult to understand the state of gender diversity in this space specifically. As a surrogate, I will be taking a broader approach, by exploring the differences in employment in both technical and non-technical industries.

These figures will give an indication and insight into the number of women vs men exposed to these emerging technologies, through employment in technical industries.

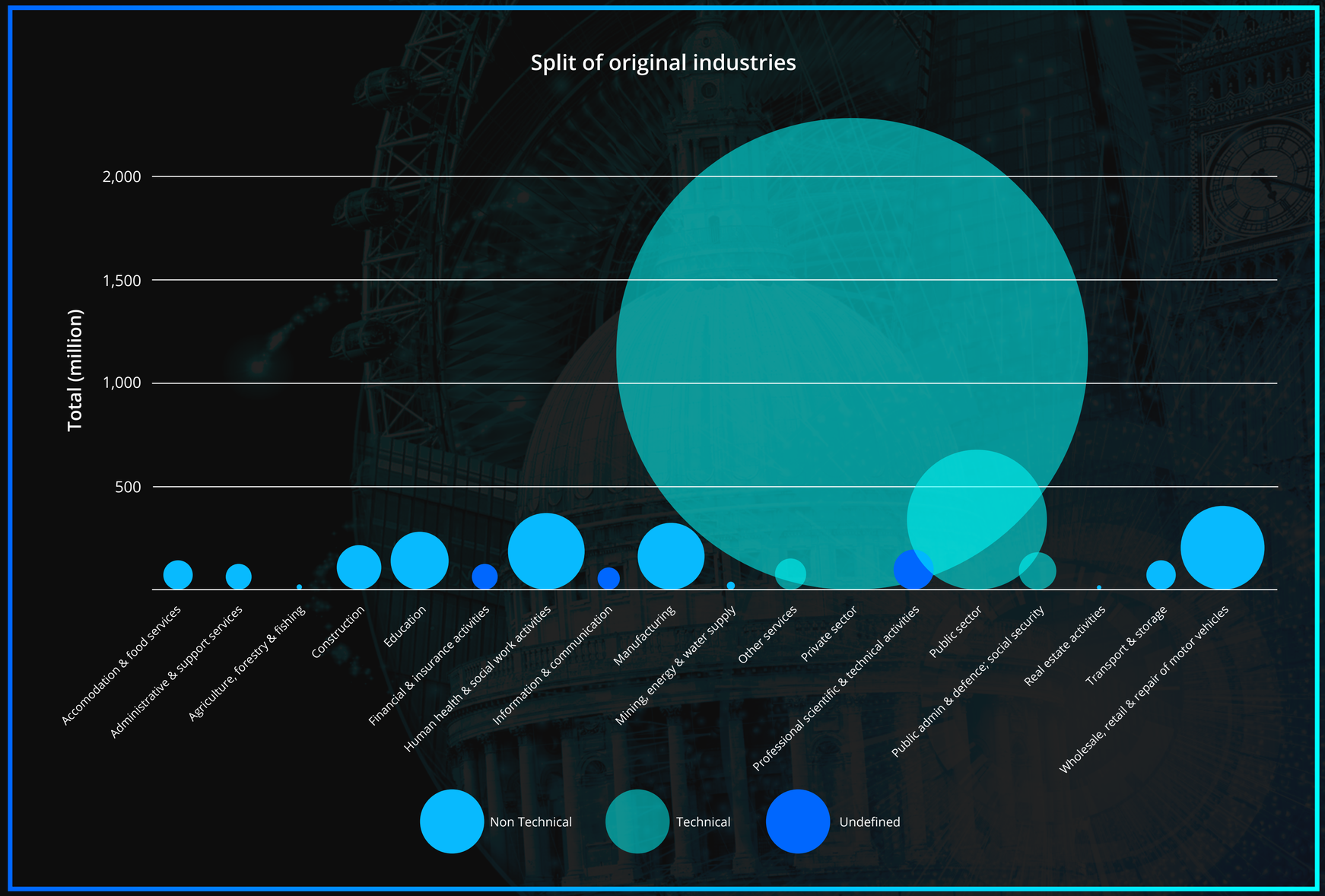
Dataset

The dataset that I will be utilising is publicly sourced from the office for National Statistics, displaying the figures for male and female employment across 18 different industries.

If you would like to take a look at the data, you can find the latest version here: EMP13: Employment by industry - Office for National Statistics (ons.gov.uk). For this piece, I used the May 2022 version which covers data from January 1997 to December 2021.

To gain the value from this data, I split these into ‘Technical’ and ‘Non-Technical’ which would allow better insights to be drawn from visualisations. The graph on the right visualises how the industry data has been split:

I have removed data which could not be split into either (categorised as ‘Undefined’ above), for example the public sector could refer to technical or non-technical tasks, so has been excluded for the sake of this research.



Dataset Limitations

The current split of the dataset has led to a drop of 55.9% of ‘undefined’ roles. I am therefore using a sample of 44.1% of the data, which could be accurately categorised, in my predictions. As a result, visualisations could be limited since there are high employment figures in e.g., ‘Public sector’ and ‘Private Sector’, though the lack of clarification on role types means that they need to be removed for reliable outputs.

I can also identify that we have 11 non-technical industries and 3 technical industries, which means that our data is imbalanced with a higher number of non-technical industries displayed. This could, however, be down to the groupings of the industries, whereby an example of a technical industry is “Professional, scientific and technical activities” which is broad and could account for numerous roles.

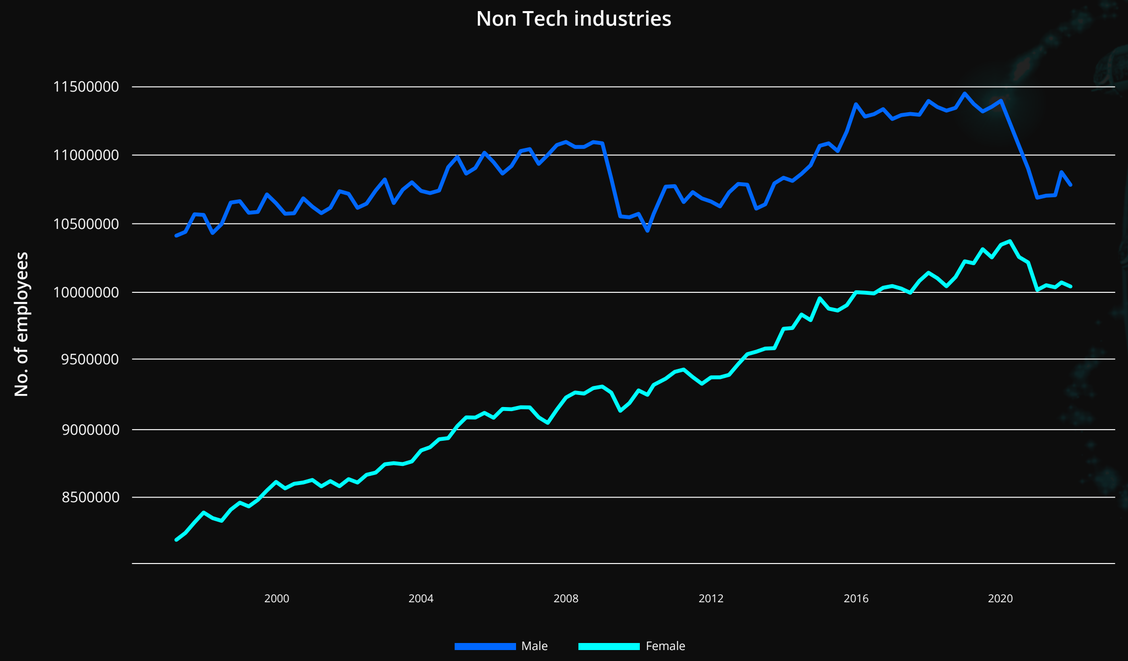
I will be considering similar studies and predictions to test the reliability of these predicted trends.

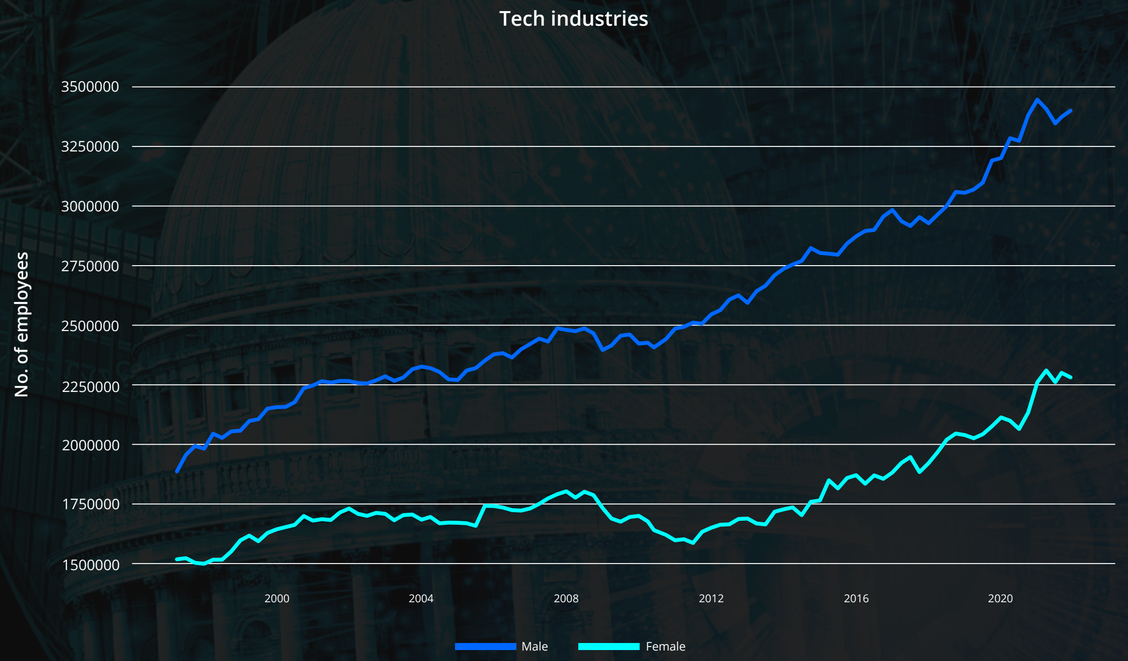
According to technation, women account for 50% of the workforce as a whole, but when it comes down to tech, this is only 26%[1]. When comparing this to the sample of data we are working with, we can see that the percentage of women in the workforce is represented at 47%, very close to the figures from technation’s data.

Though, whilst technation collated that 26% of the tech workforce were represented by women in 2021, the data used in my research suggests women accounted for 40% of the tech industry. When running these calculations for 2020 ONS data, I received a result of 39% representation of women. Thus, even though my data is imbalanced towards non-technical industries, we can see an overrepresentation in the tech industry within our sample. This should be considered when evaluating the results.

Visualisations

Prior to forecasting efforts, I loaded my data into python for some simple visualisations on the position of men and women in these industries over time. Here are the results:





Based on the data sample, we can notice that there are fewer female figures in comparison to male figures in both industry groups. It is also suggested that the number of employees in Non-Tech industries is much higher than that of Tech industries. Our data shows that male employment reached up to 12 million in the mid-late 2010s for 'Non-Tech', though in 'Tech', the maximum reached only 3.5 million male employees.

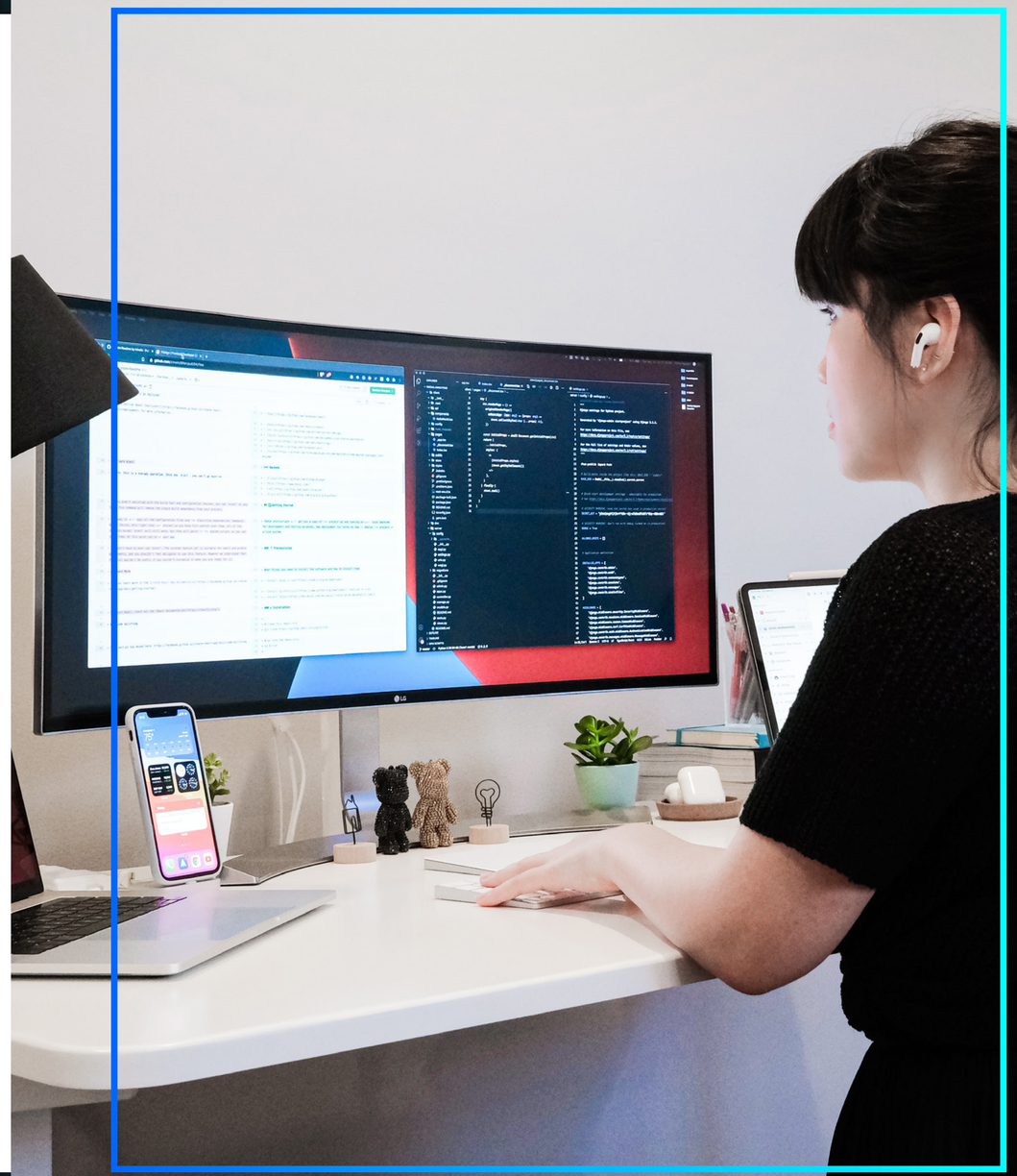
The key question of interest is: Does the data suggest that we are seeing the gap between male and female employment in tech related industries decrease?

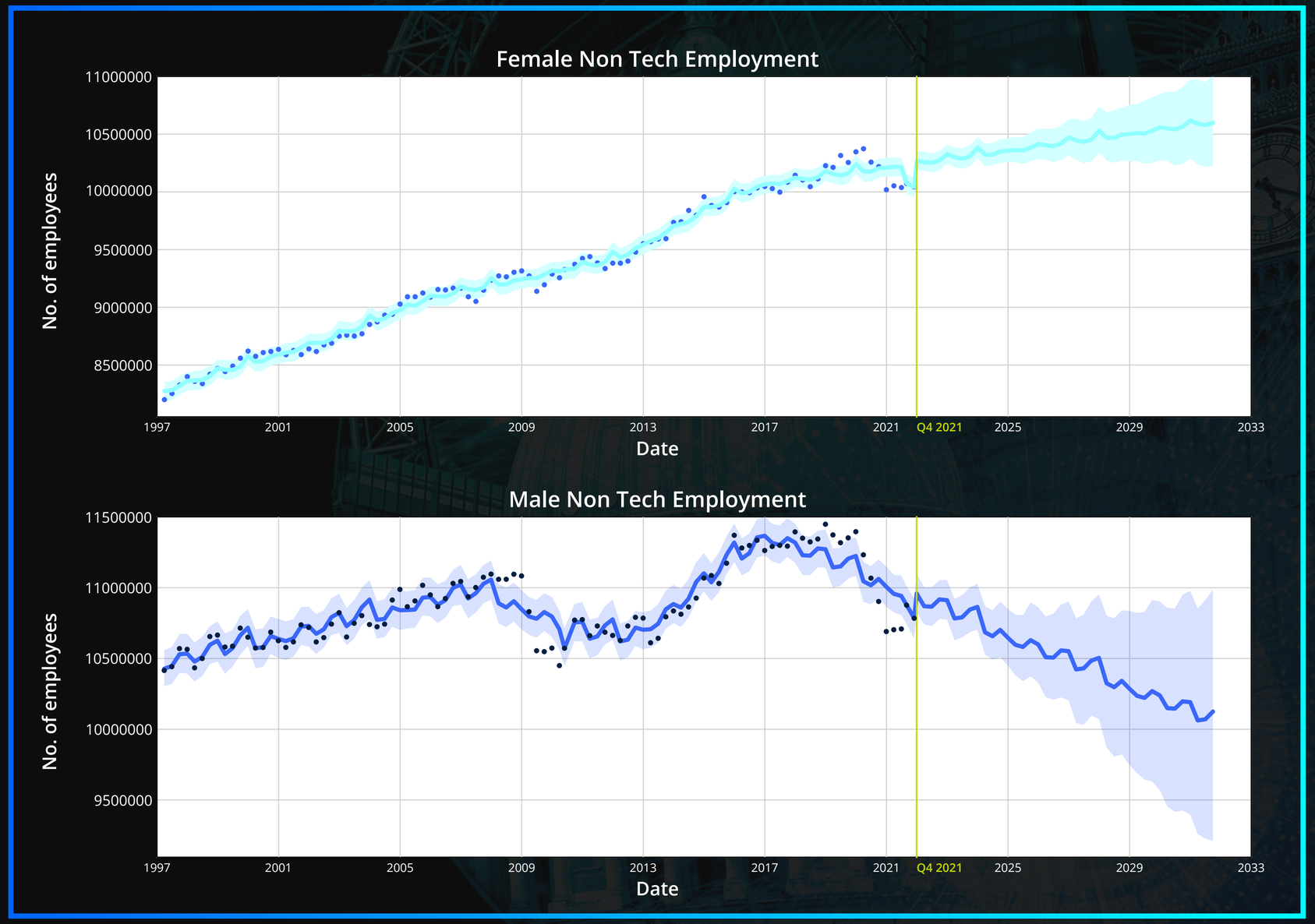
Based on the collated data, the gap between male and female employment in tech related industries has widened over the years. These absolute figures show a difference in male and female employment of 368,871 in 1997. However, in the last quarter of 2021, this difference has shot to 1,119,208.

In comparison, we can see a closing gap in the non tech industry over the years. When looking at the first quarter of 1997, the difference between male and female employment in non tech industries sat at 2,003,459, though this figure has dropped drastically to 572,983 in the last quarter of 2021.

Fb prophet

The next step in understanding the position of women in tech and AI, is forecasting the rate at which this could change in the future. To conduct predictive analysis, I will be using fbprophet, a Facebook model available to install in python which is a simple open-source method to predict time series data.



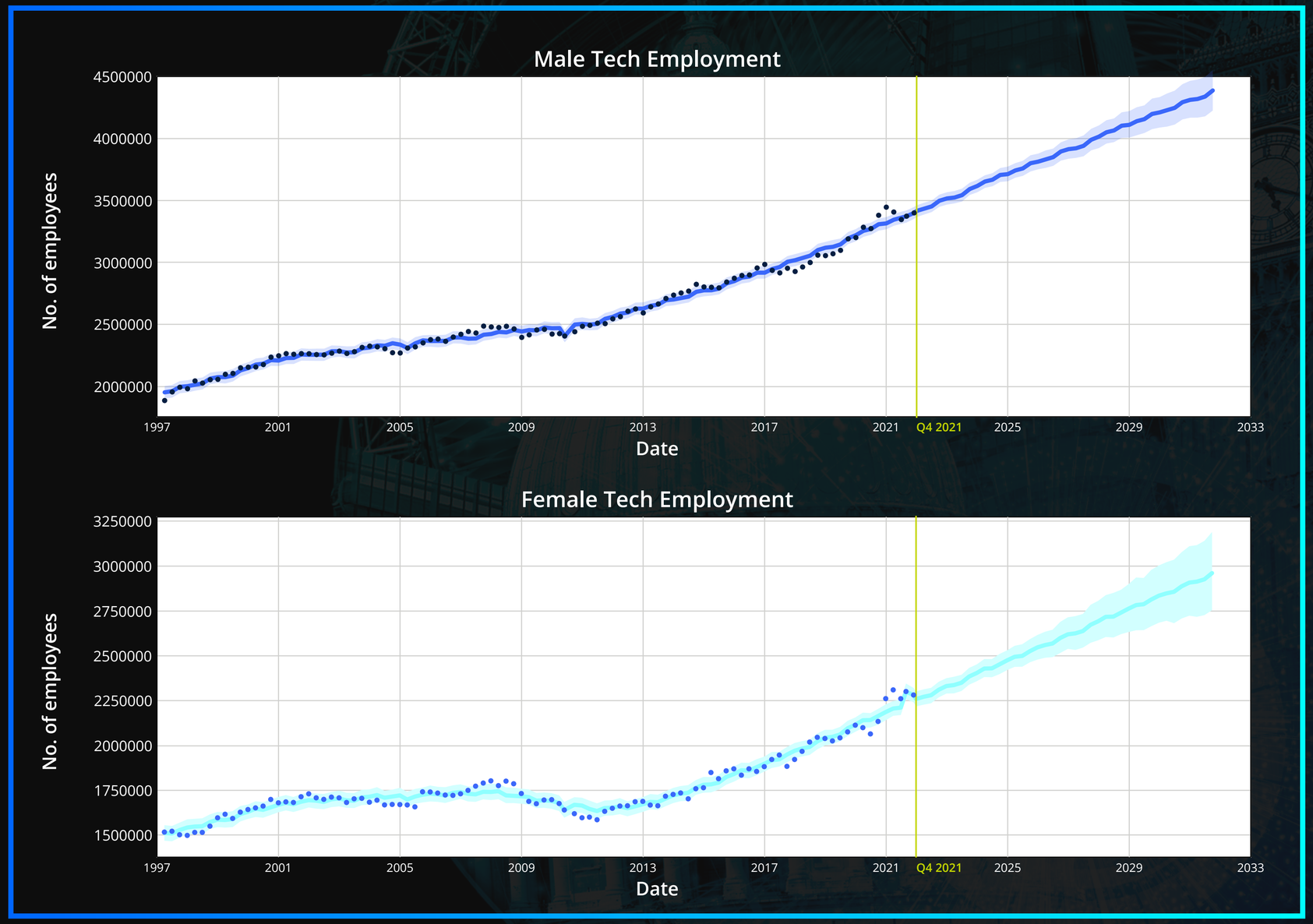


Results

Looking at the non tech industries first, below are my forecasting results. The future predictions begin beyond the red line, which marks the last point of our dataset. You may notice a shaded region; this is our confidence interval in which the unknown values lie.

The general trend predicted by the model is that female employment in the non tech industry is not expected to change drastically, but rather is likely to level off or increase.

The Prophet model predicts a clear decrease for male Non-Tech employment figures. The figures are expected to reach lower than all the data recorded, suggesting a steer of male employment away from non-technical careers.



Contrastingly to men in non tech industries, we can see an approximate increase of 1 million male employees in tech industries in the coming years. This trend provides evidence to suggest that there could be a shift in male employment, moving from non-technical to technical careers. This model is predicting that male employment will outperform historical data, reaching over 4 million male employees by 2030.

Female figures in tech employment are also predicted to increase, with figures potentially reaching over 2.8 million by 2030. There is, however, a slower rate of increase compared to male employment figures.

Model Accuracy

More important than ever, the focus of AI solutions should be ensuring responsible AI practices. Thus, when using an algorithm to predict future dates, there needs to be an assessment of the accuracy of your predictions.

To do this, I have utilised a python library called sklearn.metrics which consists of packages for calculating r2 score, mean squared error and mean absolute error.

R2 score - I received a score of 0.89, which details that 89% of variance within the data can be explained. However, in this context and with the model used, this could indicate my data is overfit, causing a very high result.

Mean absolute error (MAE) - This calculation is useful for understanding the possible error with each data point. When in the context of millions of employees, a MAE score of 83,338 is not that extreme and should not drastically impact the accuracy of future data points.

Now that we have evaluated the reliability of our model... What can we take away from this analysis?

Key Takeaways

Prophet Model Results

Taking into account the results with the sample of data used, it is shown that female employment in Tech related industries has continued to rise from the early 2010s and is predicted to continue over the coming years. In the last quarter of 2021, the data displays a difference of 1,119,208 more men than women in tech related industries and based on the forecasting results, this difference will reach approximately 1,350,000 in 2030.

Comparison to Alternative Data and Studies

I want to see how well the Prophet model has performed, so I will be delving into similar studies and statistics to see if the trends align.

Though it is difficult to find historical studies ranging from 2010, another sample of data, consisting of 150 organisations, revealed that the number of women in tech increased by 2% from 2020 to 2021 [2]. The data used in this analysis shows the female employment figures increased by 7% in this time which aligns based on the trend, though the figures from this study overrepresent the technical industry.

There is also evidence to support that women are underrepresented in the tech space, following the Alan Turing report which discusses that the UK is behind when it comes to tech diversity and ranked 5th place in the Women in Technology Index [3].

Women in Tech [4] released an article surrounding the future of women in IT, which although does not consider the entirety of AI and tech, this should give a good indication of how we can expect related industries to act. At current, the article details that only 1 in 6 tech specialists in the UK are women and only 1 in 10 are IT leaders. From these statistics, this supports the idea that right now, females are underrepresented in the space of AI and Tech.

To mark a difference in the space, it is suggested that career progression needs to improve in order to keep women within IT and Tech, giving them a solid reason to stay and not move onto careers with better rewards in sight. This logic aligns with our findings which is that given the current trend, female representation will have stunted growth in comparison to their male counterparts in tech. We need to act to bring about change and ensure we increase gender diversity.

When it comes to building AI solutions, it is more important than ever to have diverse teams to abide by responsible AI principles. An overrepresentation of a certain group could cause rise to bias, even if unintentionally, thus there needs to be further efforts to ensure we see a changing trend. So how can we promote gender diversity in this space and help close this widening gap?

Changing the Trend

Below I have put together some key practices, combined with some tips sourced from Forbes [5], which could help further celebrate and promote this space to women.

- **Diverse Employment**
  One thing business can consider is that when hiring resources, there are methods in place to ensure gender and racial equality. This in turn will help retain a diverse workforce and prevent any bias which could impact women applying for these roles.

- **Education is key**
  As a woman in data science, I had very little knowledge and exposure as to what a career in data looked like and certainly had no vision of the capabilities of AI prior to joining Deloitte over 2 years ago. Since embarking on this journey, I have become skilled in technologies that previously I did not know existed. So how can we make these opportunities more visible and show more young women what a career in AI and Tech could look like?

  Volunteering is a great way to help support diversity in the space through visiting schools, and those that may be underperforming, or which may not have funding to teach such tools and technology. This provides a great way to work with young people and break the stereotypes associated with technology.

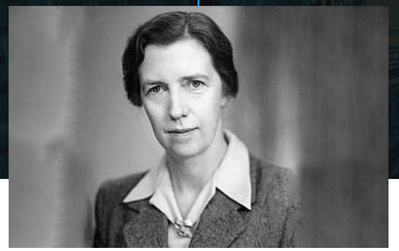
- **Attending conferences**
  The promotion of attendance to women in AI/Tech/Data conferences is a great start in engaging employees with diversity efforts. It is also a chance to hear first-hand experiences and case studies of some amazing achievements by women.

- **Celebrate and promote female role models within AI**
  A way to inspire women today to advance into AI and technology, is to showcase the women that have led and are leading amazing pieces of work within the space. Promoting female role models will give young women a figure they can relate to and aspire to be. Women have been huge in technical developments, here is a look into some females who have put their mark in AI...

Ada Lovelace

1815-1852

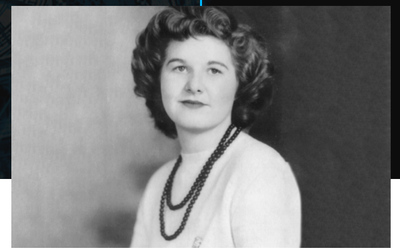
A key pioneer in the history of computing. Ada built the foundations of computers and also was responsible for writing the first instructions for the first computer program[1]



Mary Lucy Cartwright

1900-1998

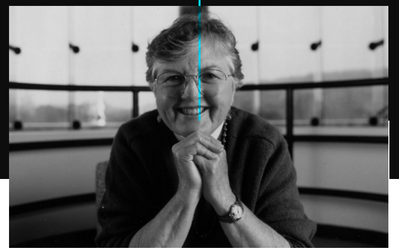
At a time when women had just been able to pursue university, Cartwright graduated from Oxford university studying mathematics. She led a career in analytic function theory and studied what was later to be known as ‘chaos theory’.[1]



Jean Jennings Bartik

1924-2011

A notable figure in the history of AI, Jean was one of the first women to work in computer science. She went on to become one of the first programmers for the US Army.[1]



Frances E Allen

1932-present

Frances has received many rewards to mark her incredible achievements in the field, being the first women to receive an Alan Turing award. Examples of her work include aiding the development of compilers for iBM machines and high level code breaking for the national security agency.[1]

Cassie Kozyrkov

Present

A leading figure in the world of AI today, Cassie is a chief decision scientist at Google. Her current role revolves around decision intelligence, where she combines the field of data science with behavioural science.[2]

1. https://blog.re-work.co/female-data-science-pioneers-you-may-not-have-heard-of/
2. https://blog.re-work.co/top-women-in-ai-2020/

Interested about how to make predictions using fbprophet?

Feel free to access my code and data sources on:
courtneybrett/WomenAI (github.com)

Check out some similar research from Deloitte:

https://www2.deloitte.com/global/en/pages/about-deloitte/articles/deloitte-women-in-ai.html

https://www2.deloitte.com/us/en/pages/consulting/articles/state-of-women-in-ai-today.html

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Women in Technology | The future of Women in IT - Women in Technology

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