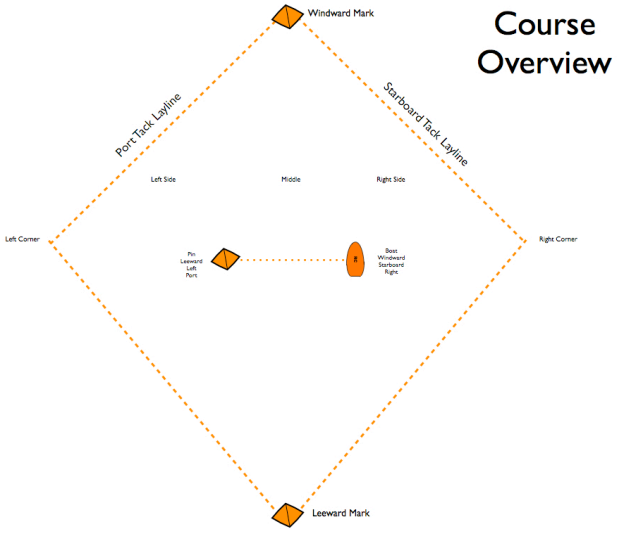
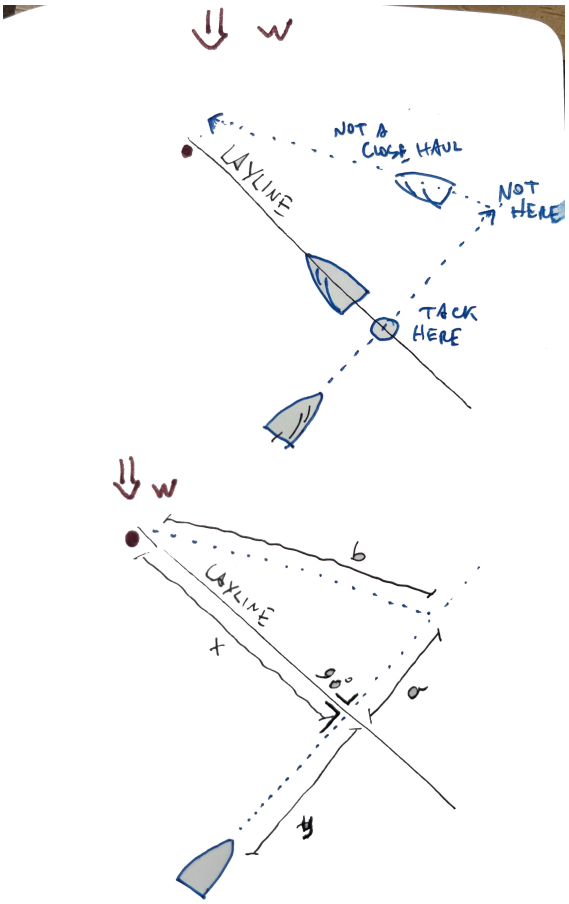
03 Laylines

Laylines are imaginary lines that indicate the optimal trajectory to reach a given point. They should not be confused with ley lines, which are for superstitious people, so the spelling is important to avoid awakening evil spirits.
When applied to racing and mark roundings, the concept of laylines is used to decide the best point to tack or gybe to get to the windward or leeward mark. For example: the starboard tack layline to the windward mark (see image below) is the closed haul course that a boat needs to be on to get to the mark in one leg. When going upwind, we either can do multiple tacks to get to the mark until we know that we will go around it, or we can try to do a small number of legs and find the exact point in which we should tack to get to the mark. We are on a layline when we know that, with only one tack, we will be able to get to the mark.
The same applies to gybes when going on a broad reach.



If we go past the layline, we will need to bear away as we will no longer be on a closed haul; in racing terms, this means that we will sail a longer course than necessary and therefore we might lose positions. The illustration below should clarify this concept.

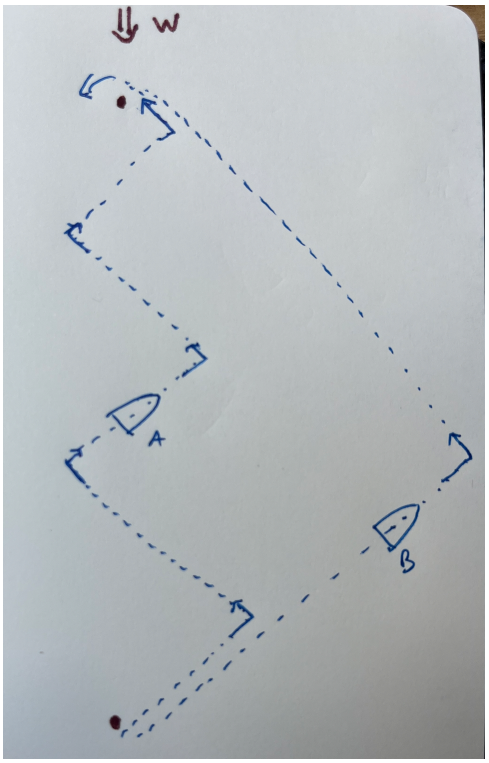


If we tack on the layline, our course length will be C = x + y.
If we tack past the layline, C = y + a + b, but Pythagoras tells us that a + b > x.
This case assumes that the angle between tacks is 90°, which is a good angle and relatively accurate for most boats, but the same thing can be demonstrated with trigonometry (you'll need to use sin and cos values).

Hitting laylines

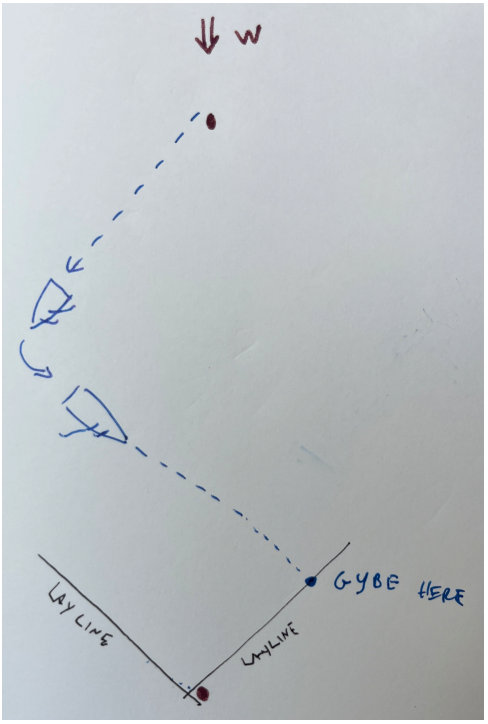
While going upwind, consider that a tacking boat does not describe a turning circle the way a car would. Its leverage turning point is where the tiller is and, combined with the momentum given by the speed, this means that the boat will turn around a point that sits somewhere around the main sheet attachment point. You should also consider that, after a well performed tack, you new direction should be perpendicular to the previous one. Usually, if the helm loos back and sees the mark aligned with their shoulder, it means the boat is hitting the layline and it is a good moment to tack. The further away you are from the mark, the more difficult it is to hit the layline because of visibility, current, waves, wind shifts, etc. So consider doing a couple of approaching legs to get closer before trying to evaluate the alignment.

Note: in an ideal course, there is no difference in the distance covered by a boat that does multiple tacks and a boat that only does one to get to the mark (boat A and boat B travel the same distance). In reality, the conditions might differ and as a result of that boat A could cover the same distance in less time (more wind on the centre of the course), or boat B could benefit from a big shift and have a more direct line to the mark.



You can use a compass to see the angle between tacks and verify the course to the mark. For example: wind direction S (180°). Starboard tack direction: 180° - 45° (ideal world) = 135°- Portack direction: 180° + 45° = 225°. Assuming constant wind, if heading 135° before the tack and 230° after, it means you overtacked. This helps you work on the manoeuvres, but also to check the mark alignment: point the compass at the windward mark and see the reading, if the angle is closer to the wind than you direction will be after tacking, it is still early. If the angle is wider, you're a bit late on the layline. Same example: wind direction S 180°. You're on a portside tack (225°) and you point the compass at the mark. The compass reads 210°. But if you tack and try to stay on a 210° course, you'll end up in irons, which means that you need to wait until the compass to the mark reads the angle that you can make, in this case 225°, before tacking.
It is better to wait a bit more and be sure to round the mark, rather than pinching the boat to death in the desperate hope to make it. It is also more dignified, to be frank

Going downwind, the same principle applies, especially if we decide to stay more on a broad reach instead of a runner (to apply the 90° rule that you have for tacks, you can keep a course that maintains the windex perpendicular to the boat axis, that will give you a fast broad reach, since the windex shows apparent wind direction, not true wind).



Exercise 3.01

One person with a compass, try to calculate the wanted layline based on wind direction (in theory you should integrate tidal currents but let's keep it simple for the sake of understanding the concept).

Exercise 3.02

No compass, but develop the directional skills to understand where you will be going after the tack, and try to be precise in getting to the mark. Pair the layline exercises with the previous ones on fitting at least 5 tacks and 5 gybes within each leg.