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Professor Kyle likes to often repeat, “it is better to approximate the answer the right question than to get an exact answer to the wrong question.” Each play one role in the process of “Validation and Verification”. As we briefly discussed in our numerical PDE course, validation asks if we are solving the right equation and verification asks what order of accuracy if any it has with regards to codes that solve PDEs.

The source describes a few testing methods that help us achieve this. Simple ones are trend predictions and using an “expert” (your expert judgment in this case) to determining is the trend is achieved. Similarly, there are a priori knowledge of symmetry for a test. Another is a comparison test to another tool that already solves a similar problem, but the worry is that often no comparable code can be found and anything else would be comparing apples and origins. Additionally, this test may also lack generalizability.

The next suggested step and method is to use a slew of exact solutions known from literature to verify your code. This would lead to “adequate” verification and we assume any mistakes in the code are also small. Yet clearly this does not mean the code is generalizable for more interesting problems which is likely what we are looking for. Another issue might be that exact solution may not have a closed form even and may be difficult to reproduce effectively or quickly to compare to.

A final highly recommended method is the one of “Manufactured Solutions.” Here we get to begin with a choice of ‘solution’ and by operating on it figure out what the PDE problem would have been. This is accomplished by allowing some dimensions of functional freedom in the PDE problem. If we choose a wide space of solutions we can be more secure with comparing them with our code solutions as form of verification.

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References:

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