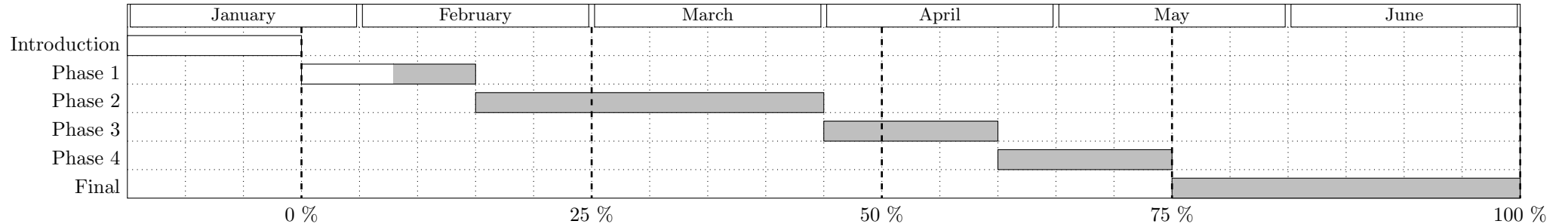


MASTER PLAN - ISAK HAMMER

SOLVING CAHN-HILLIARD EQUATION USING CUTCIP

Version: February 3, 2023

	Phase 1	Phase 2	Phase 3	Phase 4	Report
Estimated time	2-3 Weeks	4-5 Weeks	2 Weeks	3 Weeks	
Problem	CutDG for $-\Delta u = f$	CutCIP for $\Delta^2 u = f$	CutCIP for $\partial_t u + \Delta^2 u = g$	CutCIP for $\partial_t u + \Delta^2 u + f(u) = g$	
Goals	<ul style="list-style-type: none"> • Analysis <ul style="list-style-type: none"> <input type="checkbox"/> Coercivity <input type="checkbox"/> Boundedness <input type="checkbox"/> Constructing g_h based on assumptions. • Implementation <ul style="list-style-type: none"> <input type="checkbox"/> Poisson CutDG <ul style="list-style-type: none"> <input type="checkbox"/> L^2 convergence <input type="checkbox"/> H^1 convergence 	<ul style="list-style-type: none"> • Analysis <ul style="list-style-type: none"> <input type="checkbox"/> Coercivity <input type="checkbox"/> Boundedness <input type="checkbox"/> A priori estimates <input type="checkbox"/> Condition number \dagger • Implementation <ul style="list-style-type: none"> <input type="checkbox"/> First plot <input type="checkbox"/> L^2 convergence <input type="checkbox"/> H^1 convergence 	<ul style="list-style-type: none"> • Analysis <ul style="list-style-type: none"> <input type="checkbox"/> BDF analysis • Implementation <ul style="list-style-type: none"> <input type="checkbox"/> First plot <input type="checkbox"/> $L^2 L^2$ convergence <input type="checkbox"/> $L^2 H^1$ convergence 	<ul style="list-style-type: none"> • Implementation <ul style="list-style-type: none"> <input type="checkbox"/> Fixed point method <input type="checkbox"/> $L^2 L^2$ convergence <input type="checkbox"/> $L^2 H^1$ convergence 	<input type="checkbox"/> Introduction <input type="checkbox"/> CutDG $-\Delta u = f$ <input type="checkbox"/> Construction of CutDG <input type="checkbox"/> Well-posedness <input type="checkbox"/> Numerical experiments <input type="checkbox"/> CutCIP for $\Delta^2 u = f$ <input type="checkbox"/> Weak form in H^4 <input type="checkbox"/> Construction of CutCIP <input type="checkbox"/> Well-posedness <input type="checkbox"/> A priori estimates <input type="checkbox"/> Numerical experiments <input type="checkbox"/> CutCIP for $\partial_t u + \Delta^2 u = g$ <input type="checkbox"/> Time discretization <input type="checkbox"/> Numerical experiments <input type="checkbox"/> CutCIP for $\partial_t u + \Delta^2 u + f(u) = g$ <input type="checkbox"/> Fixed point methods <input type="checkbox"/> Numerical experiments <input type="checkbox"/> Conclusion
Comments	Mostly based on (Gürkan and Massing, 2019)	\dagger Not prioritized			
Digression		2nd order mixed formulation	2nd order mixed formulation	Solve $\partial_t u + \kappa(u)\Delta^2 u = g$	



What have I done this week?

- Kickstarted on the report. Got quite alot of mathematical background done.
- Getting quite close to check out coercivity, boundedness
- Implementation of Poisson for DG and CutDG.
 - **Only convergence for $k = 1$ for CutPoisson?**

What am I planning to do next week?

According to plan Should I be finished with CutDG Poissoin withing the end of next week.

- Implementation of Poisson CutDG.
- Check out all boxes in analysis.
- Finish well-posedness proof.
- Seems like I underestimated the work to prove ghost penalties and how to apply the underlying assumptions. Should I focus on face-based ghost penalties, projection based penalties or both?

Other

1) Easter 5.-10. April

References

Gürkan, Ceren and André Massing (2019). “A stabilized cut discontinuous Galerkin framework for elliptic boundary value and interface problems”. In: *Computer Methods in Applied Mechanics and Engineering* 348, pp. 466–499.