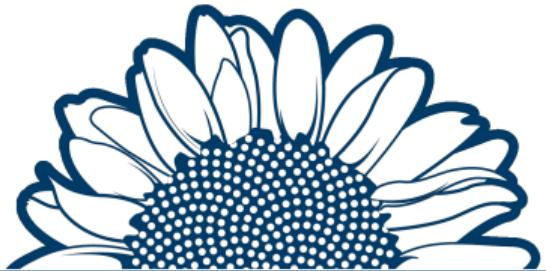


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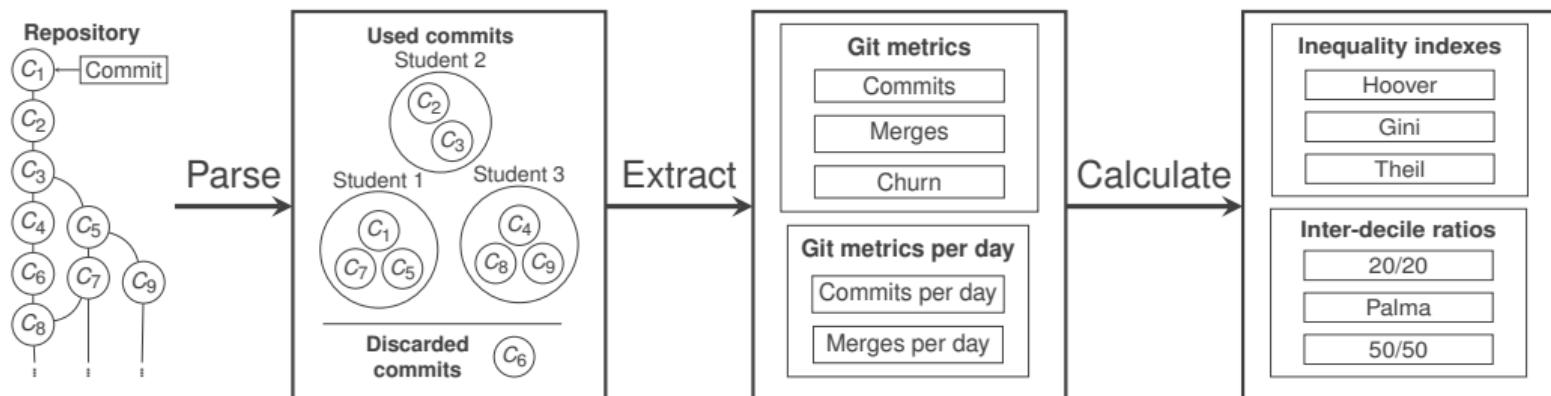


Measuring students' contributions in software development projects using Git metrics

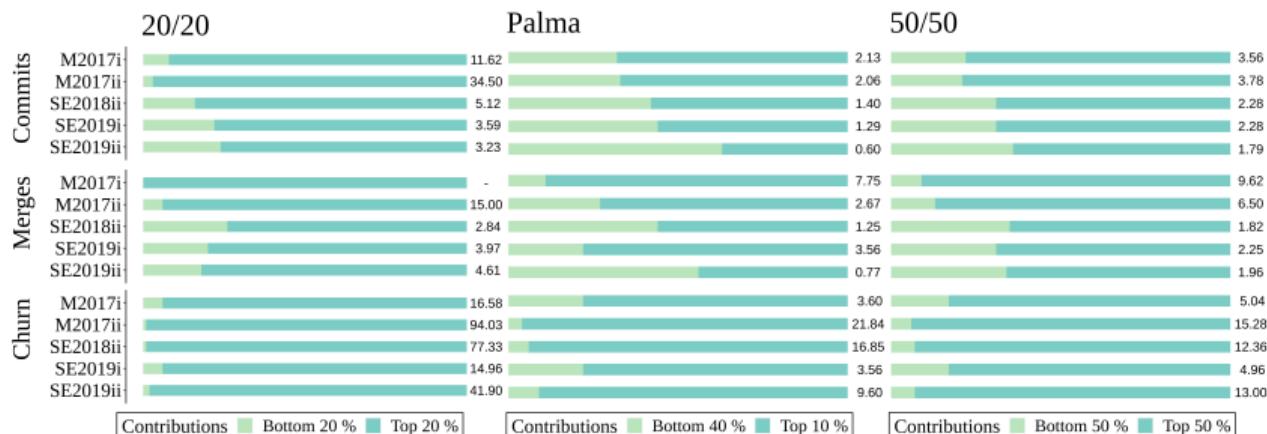
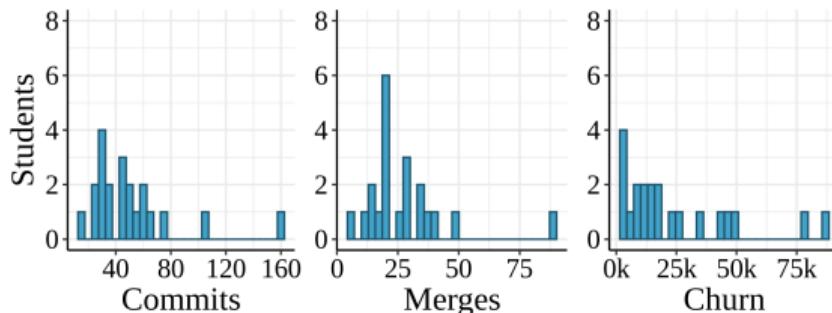
Sivana Hamer, Christian Quesada-López, Alexandra Martínez, Marcelo Jenkins
{sivana.hamer, cristian.quesadalopez, alexandra.martinez, marcelo.jenkins}@ucr.ac.cr

- Many courses of software engineering have become centered around **team-based project development**.
- **Need to assess** the contribution of students.
- Challenge of determining **individual student contribution** from team contribution.

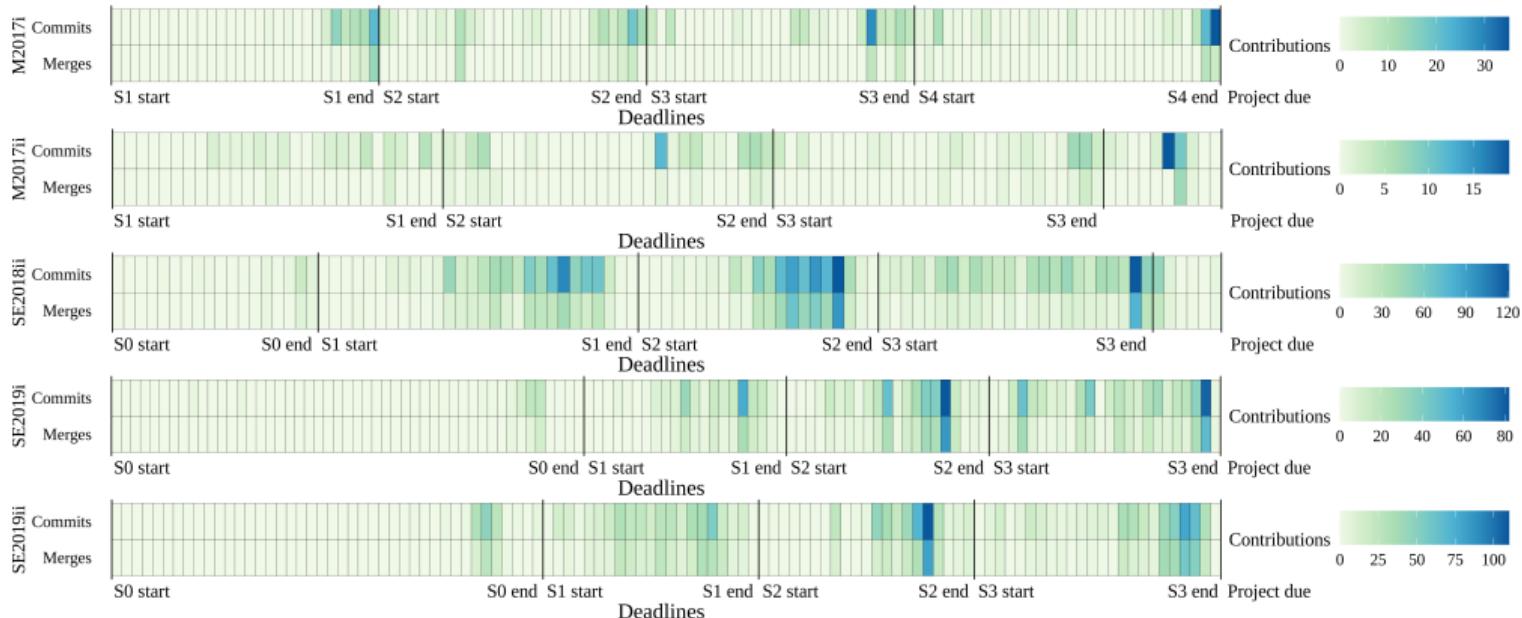
- Measure and visualize student contributions.
- 5 undergraduate software engineering projects.



■ **Inequality** in the contributions of students.

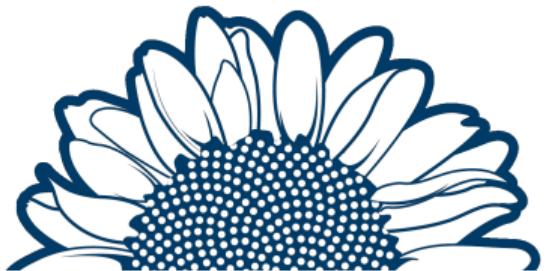


- Non-steady pace of contributions.



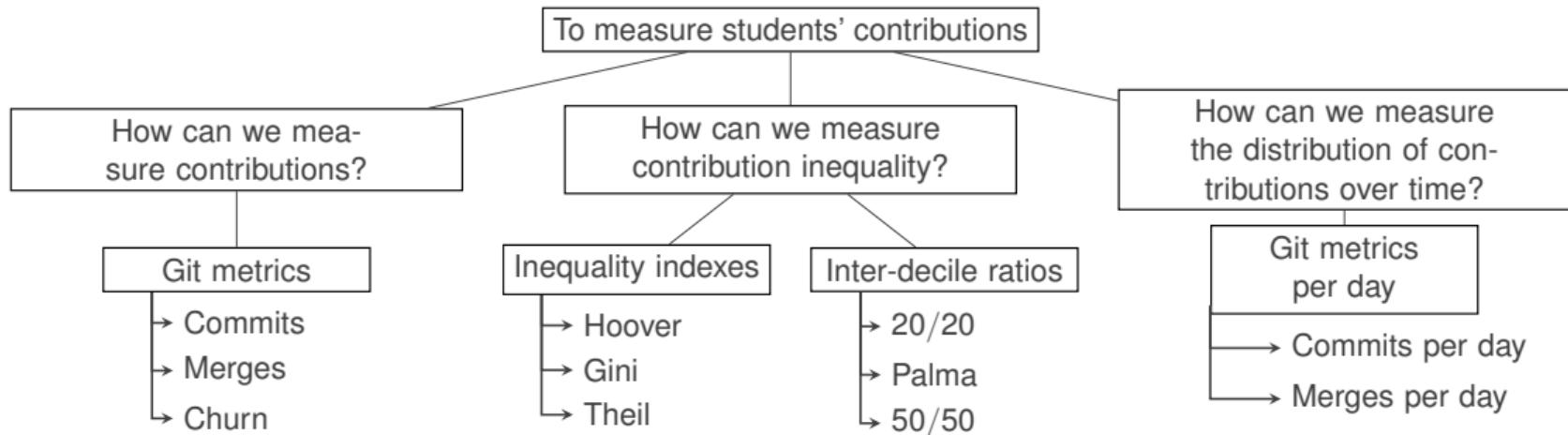
- Provides critical information to assess the **learning process**.
- In educational settings, could serve as a useful **feedback tool and fairer grading scheme**.
- In professional settings, could help **detecting risks and reward developers**.
- Future work analyzing **qualitative factors** of the contributions.

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Thank you!

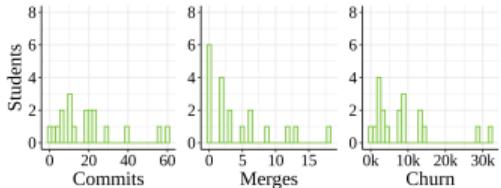
Sivana Hamer, Christian Quesada-López, Alexandra Martínez, Marcelo Jenkins
{sivana.hamer, cristian.quesadalopez, alexandra.martinez, marcelo.jenkins}@ucr.ac.cr



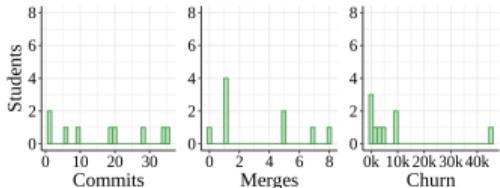
Project ID	No. of students	No. of teams	No. of sprints	Sprint duration	Year of course	Commits	Merges	Churn
M2017i	19	4	4	4 weeks	4	378	83	163,545
M2017ii	9	3	3	4 weeks	4	153	29	73,775
SE2018ii	25	5	4	3 weeks	3	2371	1106	2,132,111
SE2019i	21	4	4	3 weeks	3	1079	577	516,519
SE2019ii	20	4	4	3 weeks	3	1431	822	2,320,148

Histograms of student contributions per project

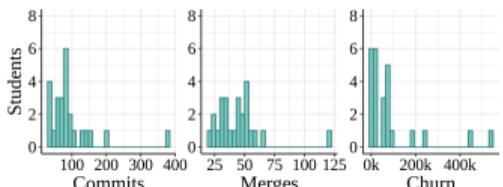
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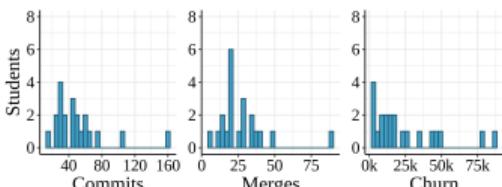
(a) Project M2017i



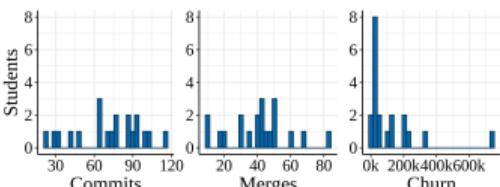
(b) Project M2017ii



(c) Project SE2018ii



(d) Project SE2019i

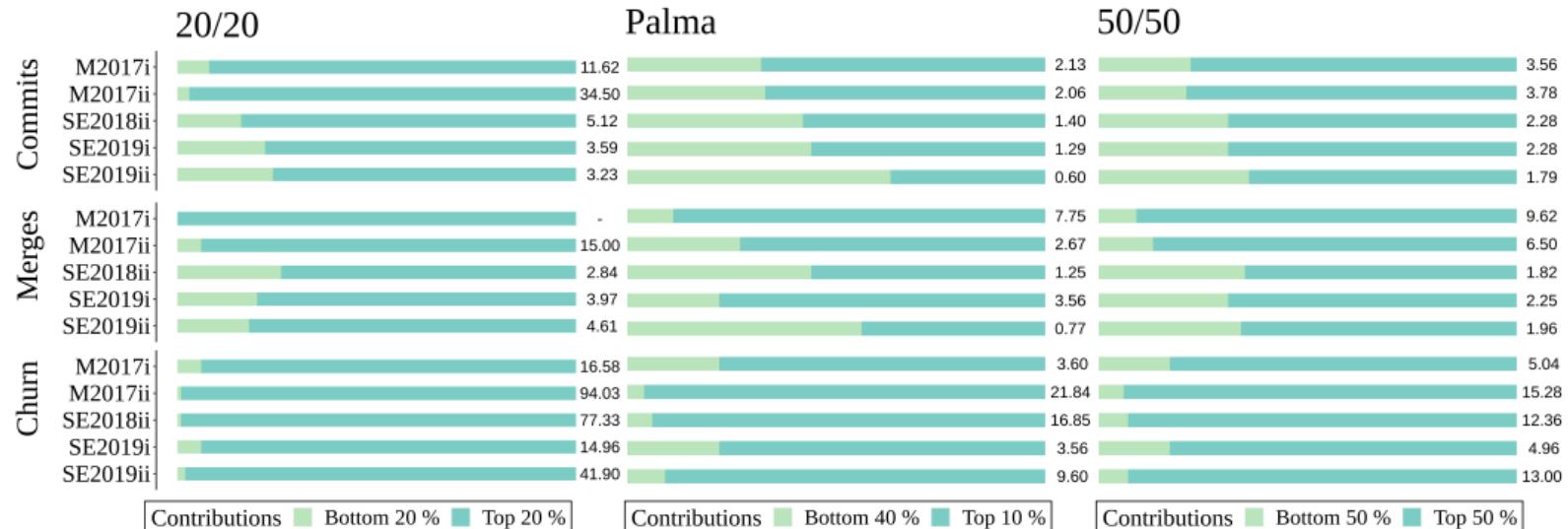


(e) Project SE2019ii

Project ID	Commits			Merges			Churn		
	<i>Hoover</i>	<i>Gini</i>	<i>Theil</i>	<i>Hoover</i>	<i>Gini</i>	<i>Theil</i>	<i>Hoover</i>	<i>Gini</i>	<i>Theil</i>
M2017i	0.2985	0.4238	0.3023	0.4629	0.5961	0.2744	0.3593	0.4951	0.4237
M2017ii	0.3333	0.4212	0.3303	0.4176	0.4751	0.3105	0.5385	0.6935	0.9422
SE2018ii	0.2266	0.3179	0.1918	0.1513	0.2147	0.0832	0.5041	0.6612	0.8257
SE2019i	0.2061	0.2888	0.1484	0.2092	0.2959	0.1569	0.3791	0.4914	0.3994
SE2019ii	0.1435	0.1991	0.0680	0.1629	0.2404	0.1038	0.4890	0.6337	0.7413

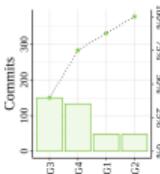
Inter-decile ratios of student contributions per project

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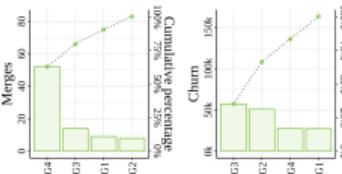


Pareto charts of team contributions per project

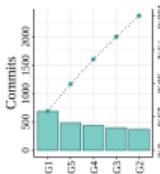
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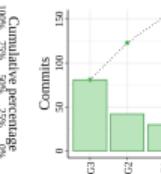
(a) Project M2017i



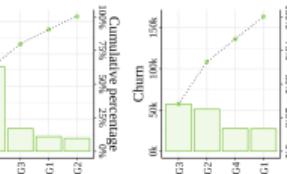
(b) Project M2017ii



(c) Project SE2018ii



(d) Project SE2019i

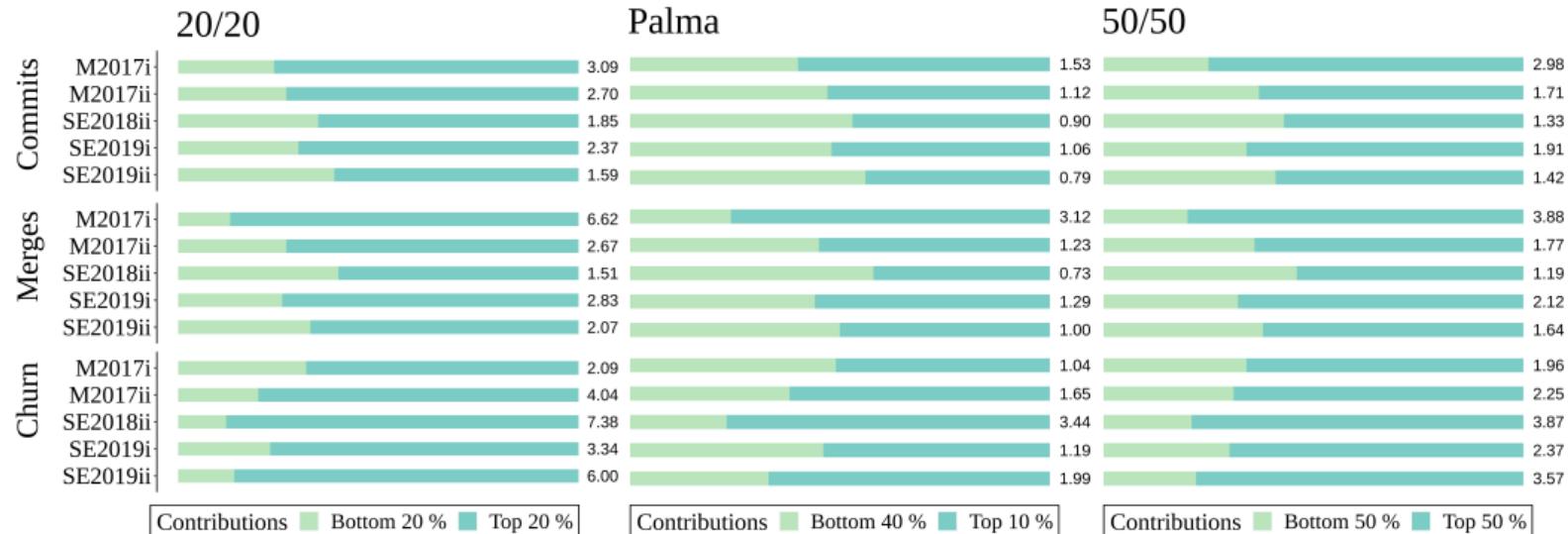


(e) Project SE2019ii

Project ID	Commits			Merges			Churn		
	<i>Hoover</i>	<i>Gini</i>	<i>Theil</i>	<i>Hoover</i>	<i>Gini</i>	<i>Theil</i>	<i>Hoover</i>	<i>Gini</i>	<i>Theil</i>
M2017i	0.2487	0.2540	0.1296	0.3886	0.4187	0.3431	0.1621	0.1724	0.0546
M2017ii	0.1961	0.2222	0.0876	0.2184	0.2299	0.1014	0.2900	0.3127	0.1813
SE2018ii	0.0922	0.1210	0.0265	0.0586	0.0763	0.0111	0.3742	0.4098	0.3025
SE2019i	0.1562	0.1837	0.0557	0.1794	0.2231	0.0829	0.2035	0.2253	0.0978
SE2019ii	0.0863	0.1036	0.0185	0.1271	0.1582	0.0444	0.2811	0.3222	0.1855

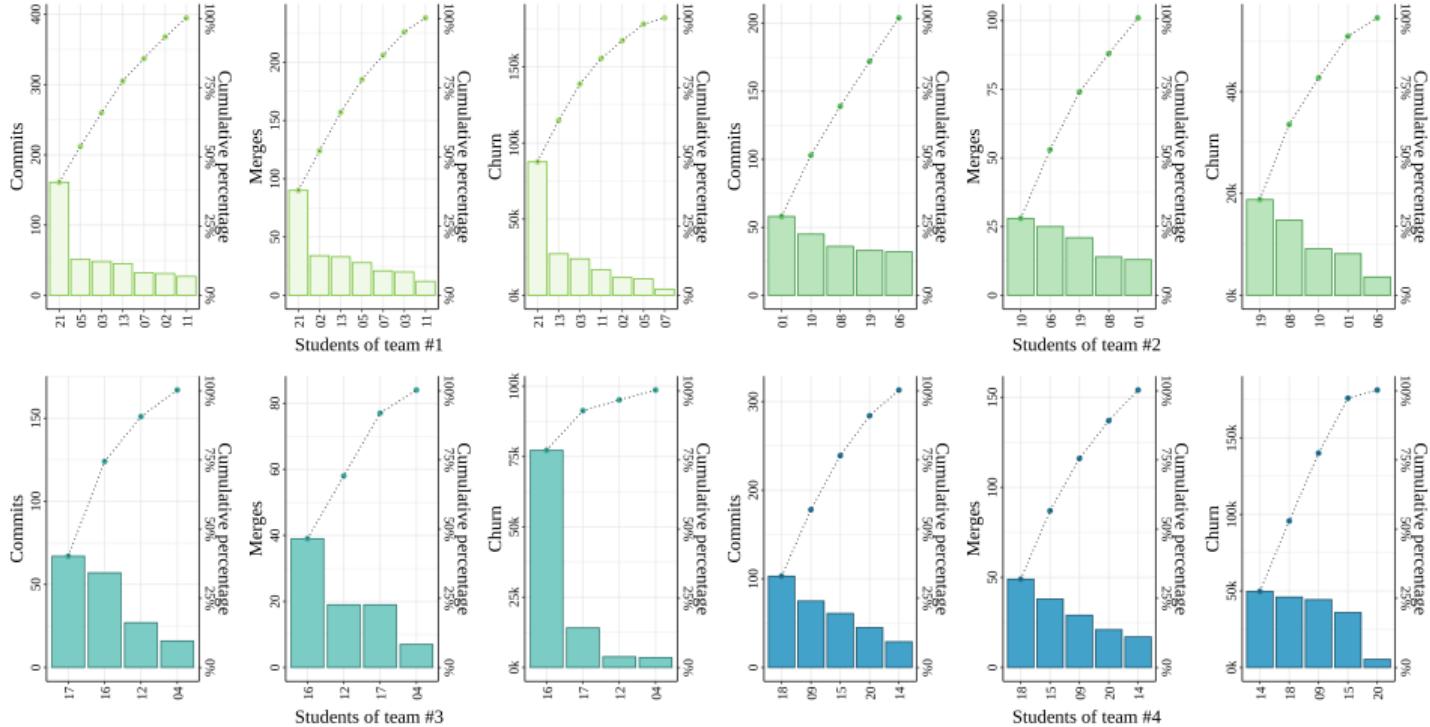
Inter-decile ratios of team contributions per project

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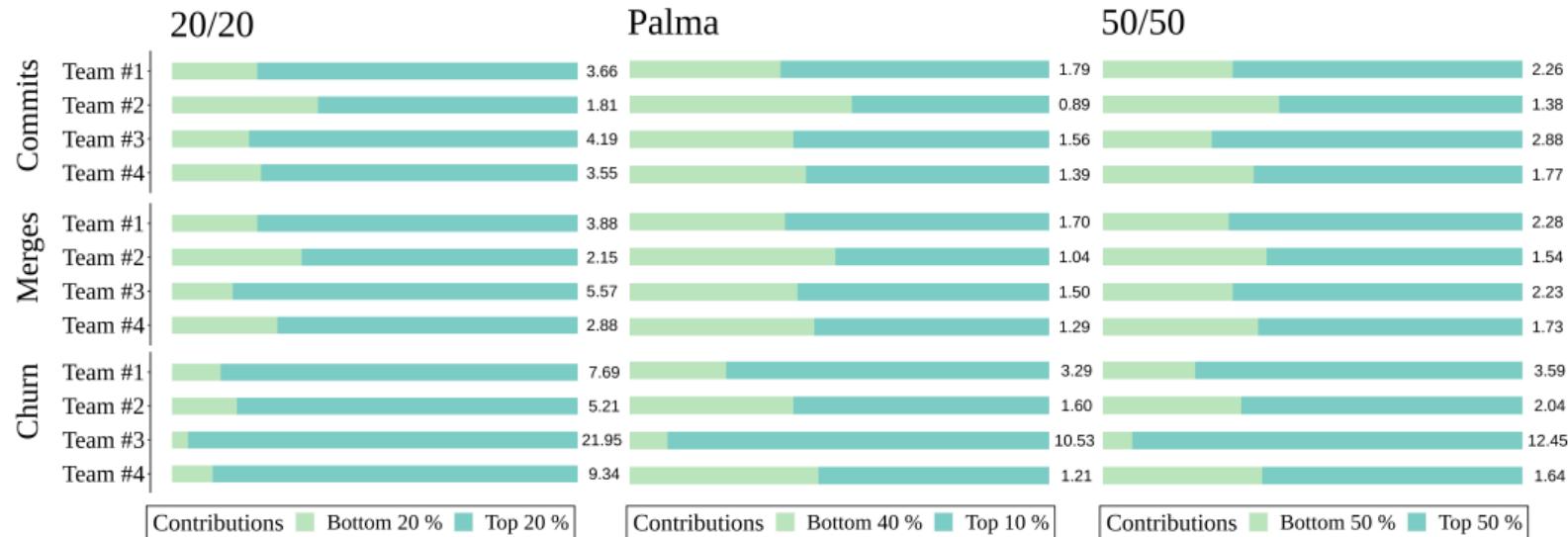


SE2019i pareto charts of student contributions within teams

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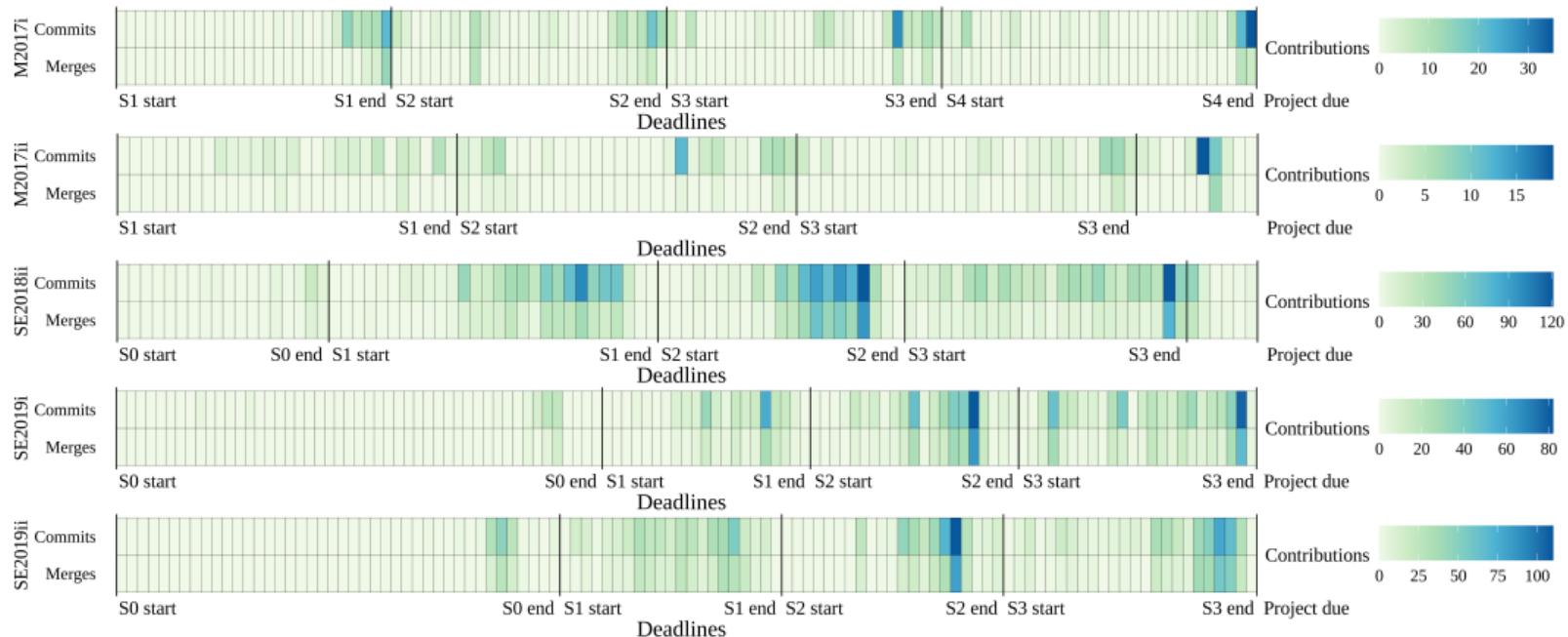


Project ID	Commits			Merges			Churn		
	<i>Hoover</i>	<i>Gini</i>	<i>Theil</i>	<i>Hoover</i>	<i>Gini</i>	<i>Theil</i>	<i>Hoover</i>	<i>Gini</i>	<i>Theil</i>
Team #1	0.2647	0.3313	0.2255	0.2353	0.3289	0.2015	0.3449	0.4636	0.3940
Team #2	0.1049	0.1255	0.0271	0.1327	0.1624	0.0438	0.2160	0.2715	0.1246
Team #3	0.2425	0.2740	0.1337	0.2143	0.2857	0.1506	0.5328	0.5864	0.6719
Team #4	0.1687	0.2275	0.0834	0.1649	0.2104	0.0704	0.1727	0.2183	0.1379



Heat map of contribution frequency of students to projects

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Heat map of contribution frequency of teams to projects

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