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A Python Module for Standardized Job Shop Scheduling Benchmark Instances

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Abstract

The Job Shop Scheduling Problem (JSP) is a core challenge in operations research, often used to benchmark optimization and machine learning algorithms. Although many benchmark instances are publicly available, their formats typically require preprocessing before integration into Python-based research workflows. A Python module named jsp-instance-utils has been developed to provide ready-to-use JSP benchmark instances in a standardized format. Benchmark instances were obtained from the public repository jobshop.jjvh.nl. Each instance was parsed and converted into a NumPy, the de facto standard in Python scientific computing. The instances were then consolidated into a Python module to simplify direct access without needing textfile parsing. The dataset and software are published following the FAIR principles. Persistent identifiers and metadata allow users to locate the dataset across platforms such as GitHub, GitLab, PyPi, and Zenodo. Access is unrestricted, and no registration or proprietary tools are required. The complete data acquisition and conversion code is documented, allowing users to reproduce or extend the dataset using the same procedures. The module also includes a baseline solver using Google OR-Tools Constraint Programming Solver. The solver provides a benchmark solver against more sophisticated Algorithms allowing comparisons without requiring additional software installations. Utility functions for generating custom instances beyond the provided dataset are also included. Documentation is provided through Read the Docs and covers installation, function usage, and practical examples, including integrating benchmark instances into reinforcement learning pipelines for JSP. The software is implemented in Python and released as open source. The provided dataset and software reduce technical overhead in JSP research and promote reproducibility. Publishing according to FAIR principles ensures that the data can be found, accessed, used in different systems, and reused in future research contexts. The module assists optimization and learning-based scheduling research by aligning benchmark availability with modern Python workflows.

Resources

The dataset, along with its utility functions and the Python modules for obtaining the dataset, is published in the repository `jsp-instance-utils`, which is available across

multiple platforms. The source code is openly accessible on *GitLab* and *Github*. The compiled software package is distributed via *PyPi*, enabling users to install it using the Python package manager `pip`. Comprehensive documentation is hosted on *Read the Docs*, providing detailed information about the dataset and the utility software module functionalities. The documentation includes a tabulated overview of all contained benchmark instances and their references, ensuring transparency. Additionally, various example applications are provided, demonstrating how the dataset and module can be leveraged in different research scenarios, including state-of-the-art Reinforcement Learning approaches.

The lasted version of `jsp-instance-utils` (version 1.0.4) is published on *Zenodo*, enabling researches to refer to dataset using the DOI-Identifier.

- jsp-instance-utils **DOI**: 10.5281/zenodo.15063451
- jsp-instance-utils on **Gitlab**
- jsp-instance-utils on **Github**
- jsp-instance-utils on **PyPi**
- jsp-instance-utils on **Read the Docs**

Author contributions

Authors' contributions according to the CreDIT guidelines:

- Alexander Nasuta: Writing - Original Draft, Data Curation, Software
- Hans Aoyang Zhou: Writing - Review
- Anas Abdelrazeq: Writing - Review
- Robert H. Schmitt: Supervision, Funding acquisition

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Appendix

Table 1 lists all JSP instances, that are included in `jsp-instance-utils`. Each instance is characterized by the following attributes:

- **ID**: A unique identifier assigned to each benchmark instance in the dataset.
- **Ref**: A reference to the original source of the instance.
- **Jobs**: The number of jobs in the scheduling instance.
- **Machines**: The number of machines for processing jobs.

- **Makespan**: The total time required to complete all jobs.
- **Optimal**: Indicates whether the reported makespan is known to be optimal.
- **Makespan Ref**: A reference to source of the best-known solution.

Table 1. *Instances available in the dataset and their best know solutions.*

ID	Ref	Jobs	Machines	Makespan	Optimal	Makespan Ref
abz5	[1]	10	10	1234	yes	[2]
abz6	[1]	10	10	943	yes	[2]
abz7	[1]	20	15	656	no	[3]
abz8	[1]	20	15	665	no	[3]
abz9	[1]	20	15	678	no	[4]
dmu01	[5]	20	15	2563	no	[3]
dmu02	[5]	20	15	2706	no	[3]
dmu03	[5]	20	15	2731	no	[3]
dmu04	[5]	20	15	2669	no	[3]
dmu05	[5]	20	15	2749	no	[3]
dmu06	[5]	20	20	3244	no	[6]
dmu07	[5]	20	20	3046	no	[6]
dmu08	[5]	20	20	3188	no	[6]
dmu09	[5]	20	20	3092	no	[3]
dmu10	[5]	20	20	2984	no	[6]
dmu11	[5]	30	15	3430	no	[7]
dmu12	[5]	30	15	3495	no	[8]
dmu13	[5]	30	15	3681	no	[9]
dmu14	[5]	30	15	3394	no	[3]
dmu15	[5]	30	15	3343	no	[3]
dmu16	[5]	30	20	3751	no	[9]
dmu17	[5]	30	20	3814	no	[8]
dmu18	[5]	30	20	3844	no	[9]
dmu19	[5]	30	20	3768	no	[8]
dmu20	[5]	30	20	3710	no	[7]
dmu21	[5]	40	15	4380	no	[3]
dmu22	[5]	40	15	4725	no	[3]
dmu23	[5]	40	15	4668	no	[3]
dmu24	[5]	40	15	4648	no	[3]
dmu25	[5]	40	15	4164	no	[3]
dmu26	[5]	40	20	4647	no	[9]
dmu27	[5]	40	20	4848	no	[3]
dmu28	[5]	40	20	4692	no	[3]
dmu29	[5]	40	20	4691	no	[3]
dmu30	[5]	40	20	4732	no	[3]
dmu31	[5]	50	15	5640	no	[3]
dmu32	[5]	50	15	5927	yes	[3]
dmu33	[5]	50	15	5728	yes	[3]
dmu34	[5]	50	15	5385	no	[3]
dmu35	[5]	50	15	5635	yes	[3]
dmu36	[5]	50	20	5621	no	[3]
dmu37	[5]	50	20	5851	no	[3]
dmu38	[5]	50	20	5713	no	[3]

dmu39	[5]	50	20	5747	no	[3]
dmu40	[5]	50	20	5577	no	[3]
dmu41	[5]	20	15	3248	no	[7]
dmu42	[5]	20	15	3390	no	[7]
dmu43	[5]	20	15	3441	no	[9]
dmu44	[5]	20	15	3488	no	[8]
dmu45	[5]	20	15	3272	no	[9]
dmu46	[5]	20	20	4035	no	[9]
dmu47	[5]	20	20	3939	no	[9]
dmu48	[5]	20	20	3763	no	[8]
dmu49	[5]	20	20	3710	no	[7]
dmu50	[5]	20	20	3729	no	[7]
dmu51	[5]	30	15	4167	no	[8]
dmu52	[5]	30	15	4311	no	[7]
dmu53	[5]	30	15	4394	no	[8]
dmu54	[5]	30	15	4362	no	[8]
dmu55	[5]	30	15	4271	no	[8]
dmu56	[5]	30	20	4941	no	[7]
dmu57	[5]	30	20	4655	no	[7]
dmu58	[5]	30	20	4708	no	[7]
dmu59	[5]	30	20	4624	no	[8]
dmu60	[5]	30	20	4755	no	[8]
dmu61	[5]	40	15	5172	no	[8]
dmu62	[5]	40	15	5265	no	[8]
dmu63	[5]	40	15	5326	no	[8]
dmu64	[5]	40	15	5250	no	[8]
dmu65	[5]	40	15	5190	no	[8]
dmu66	[5]	40	20	5717	no	[7]
dmu67	[5]	40	20	5813	no	[8]
dmu68	[5]	40	20	5773	no	[8]
dmu69	[5]	40	20	5709	no	[7]
dmu70	[5]	40	20	5889	no	[8]
dmu71	[5]	50	15	6233	no	[7]
dmu72	[5]	50	15	6483	no	[8]
dmu73	[5]	50	15	6163	no	[8]
dmu74	[5]	50	15	6220	no	[8]
dmu75	[5]	50	15	6197	no	[8]
dmu76	[5]	50	20	6813	no	[8]
dmu77	[5]	50	20	6822	no	[8]
dmu78	[5]	50	20	6770	no	[7]
dmu79	[5]	50	20	6970	no	[8]
dmu80	[5]	50	20	6686	no	[8]
ft06	[10]	6	6	55	yes	[11]
ft10	[10]	10	10	930	yes	[11]
ft20	[10]	20	5	1165	yes	[11]
la01	[12]	10	5	666	yes	[2]
la02	[12]	10	5	655	yes	[2]
la03	[12]	10	5	597	yes	[2]
la04	[12]	10	5	590	yes	[2]

la05	[12]	10	5	593	yes	[2]
la06	[12]	15	5	926	yes	[2]
la07	[12]	15	5	890	yes	[2]
la08	[12]	15	5	863	yes	[2]
la09	[12]	15	5	951	yes	[2]
la10	[12]	15	5	958	yes	[2]
la11	[12]	20	5	1222	yes	[2]
la12	[12]	20	5	1039	yes	[2]
la13	[12]	20	5	1150	yes	[2]
la14	[12]	20	5	1292	yes	[2]
la15	[12]	20	5	1207	yes	[2]
la16	[12]	10	10	945	yes	[2]
la17	[12]	10	10	784	yes	[2]
la18	[12]	10	10	848	yes	[2]
la19	[12]	10	10	842	yes	[2]
la20	[12]	10	10	902	yes	[2]
la21	[12]	15	10	1046	no	[13]
la22	[12]	15	10	927	no	[2]
la23	[12]	15	10	1032	yes	[2]
la24	[12]	15	10	935	no	[2]
la25	[12]	15	10	977	no	[2]
la26	[12]	20	10	1218	yes	[2]
la27	[12]	20	10	1235	no	[13]
la28	[12]	20	10	1216	yes	[2]
la29	[12]	20	10	1152	no	[3]
la30	[12]	20	10	1355	yes	[2]
la31	[12]	30	10	1784	yes	[2]
la32	[12]	30	10	1850	yes	[2]
la33	[12]	30	10	1719	yes	[2]
la34	[12]	30	10	1721	yes	[2]
la35	[12]	30	10	1888	yes	[2]
la36	[12]	15	15	1268	no	[2]
la37	[12]	15	15	1397	no	[2]
la38	[12]	15	15	1196	no	[14]
la39	[12]	15	15	1233	no	[2]
la40	[12]	15	15	1222	no	[2]
orb01	[2]	10	10	1059	yes	[2]
orb02	[2]	10	10	888	yes	[2]
orb03	[2]	10	10	1005	yes	[2]
orb04	[2]	10	10	1005	yes	[2]
orb05	[2]	10	10	887	yes	[2]
orb06	[2]	10	10	1010	yes	[15]
orb07	[2]	10	10	397	yes	[3]
orb08	[2]	10	10	899	yes	[15]
orb09	[2]	10	10	934	yes	[15]
orb10	[2]	10	10	944	yes	[15]
swv01	[16]	20	10	1407	no	[3]
swv02	[16]	20	10	1475	no	[3]
swv03	[16]	20	10	1398	no	[3]

swv04	[16]	20	10	1464	no	[17]
swv05	[16]	20	10	1424	no	[3]
swv06	[16]	20	15	1671	no	[7], [17]
swv07	[16]	20	15	1594	no	[9]
swv08	[16]	20	15	1752	no	[7], [17]
swv09	[16]	20	15	1655	no	[7], [17]
swv10	[16]	20	15	1743	no	[9]
swv11	[16]	50	10	2983	no	[18]
swv12	[16]	50	10	2977	no	[7]
swv13	[16]	50	10	3104	no	[3]
swv14	[16]	50	10	2968	no	[3]
swv15	[16]	50	10	2885	no	[7]
swv16	[16]	50	10	2924	yes	[3]
swv17	[16]	50	10	2794	yes	[3]
swv18	[16]	50	10	2852	yes	[3]
swv19	[16]	50	10	2843	yes	[3]
swv20	[16]	50	10	2823	yes	[3]
ta01	[19]	15	15	1231	yes	[3]
ta02	[19]	15	15	1244	no	[14]
ta03	[19]	15	15	1218	no	[3]
ta04	[19]	15	15	1175	no	[20]
ta05	[19]	15	15	1224	no	[3]
ta06	[19]	15	15	1238	no	[3]
ta07	[19]	15	15	1227	no	[3]
ta08	[19]	15	15	1217	no	[3]
ta09	[19]	15	15	1274	no	[3]
ta10	[19]	15	15	1241	no	[3]
ta11	[19]	20	15	1357	no	[21]
ta12	[19]	20	15	1367	no	[3]
ta13	[19]	20	15	1342	no	[3]
ta14	[19]	20	15	1345	no	[14]
ta15	[19]	20	15	1339	no	[6]
ta16	[19]	20	15	1360	no	[3]
ta17	[19]	20	15	1462	no	[3]
ta18	[19]	20	15	1396	no	[3]
ta19	[19]	20	15	1332	no	[6]
ta20	[19]	20	15	1348	no	[6]
ta21	[19]	20	20	1642	no	[21]
ta22	[19]	20	20	1600	no	[3]
ta23	[19]	20	20	1557	no	[3]
ta24	[19]	20	20	1644	no	[17]
ta25	[19]	20	20	1595	no	[18]
ta26	[19]	20	20	1643	no	[9]
ta27	[19]	20	20	1680	no	[3]
ta28	[19]	20	20	1603	no	[6]
ta29	[19]	20	20	1625	no	[3]
ta30	[19]	20	20	1584	no	[3]
ta31	[19]	30	15	1764	no	[3]
ta32	[19]	30	15	1784	no	[22]

ta33	[19]	30	15	1791	no	[6]
ta34	[19]	30	15	1829	no	[3]
ta35	[19]	30	15	2007	no	[20]
ta36	[19]	30	15	1819	no	[3]
ta37	[19]	30	15	1771	no	[9]
ta38	[19]	30	15	1673	no	[3]
ta39	[19]	30	15	1795	no	[3]
ta40	[19]	30	15	1669	no	[9]
ta41	[19]	30	20	2005	no	[17]
ta42	[19]	30	20	1937	no	[9]
ta43	[19]	30	20	1846	no	[7]
ta44	[19]	30	20	1979	no	[17]
ta45	[19]	30	20	2000	no	[3]
ta46	[19]	30	20	2004	no	[9]
ta47	[19]	30	20	1889	no	[7], [17]
ta48	[19]	30	20	1941	no	[8]
ta49	[19]	30	20	1961	no	[17]
ta50	[19]	30	20	1923	no	[7], [17]
ta51	[19]	50	15	2760	no	[20]
ta52	[19]	50	15	2756	no	[20]
ta53	[19]	50	15	2717	no	[20]
ta54	[19]	50	15	2839	no	[20]
ta55	[19]	50	15	2679	no	[14]
ta56	[19]	50	15	2781	no	[20]
ta57	[19]	50	15	2943	no	[20]
ta58	[19]	50	15	2885	no	[20]
ta59	[19]	50	15	2655	no	[20]
ta60	[19]	50	15	2723	no	[20]
ta61	[19]	50	20	2868	no	[14]
ta62	[19]	50	20	2869	no	[23]
ta63	[19]	50	20	2755	no	[14]
ta64	[19]	50	20	2702	no	[14]
ta65	[19]	50	20	2725	no	[14]
ta66	[19]	50	20	2845	no	[14]
ta67	[19]	50	20	2825	no	[3]
ta68	[19]	50	20	2784	no	[14]
ta69	[19]	50	20	3071	no	[14]
ta70	[19]	50	20	2995	no	[14]
ta71	[19]	100	20	5464	no	[20]
ta72	[19]	100	20	5181	no	[20]
ta73	[19]	100	20	5568	no	[20]
ta74	[19]	100	20	5339	no	[20]
ta75	[19]	100	20	5392	no	[20]
ta76	[19]	100	20	5342	no	[20]
ta77	[19]	100	20	5436	no	[20]
ta78	[19]	100	20	5394	no	[20]
ta79	[19]	100	20	5358	no	[20]
ta80	[19]	100	20	5183	no	[14]
yn01	[24]	20	20	884	no	[4]

yn02	[24]	20	20	904	no	[9]
yn03	[24]	20	20	892	no	[18]
yn04	[24]	20	20	968	no	[3]