Donato Lab - Block course
Day 2, 24.05.2022

Introduction

- 1-Photon imaging, the miniscope
- Animal recording and tracking in open arena
- Combining neuronal events with behavior
- Processing raw data with Matlab to find Place Cells

donatolab

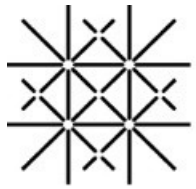
University of Basel

BIOZENTRUM
Universität Basel
The Center for
Molecular Life Sciences

Donato Lab - Block course
Day 2, 24.05.2022

Practical

- Matlab basics
- Breaking down raw data
- Tidying up the data
- Aligning behavior and neuronal data



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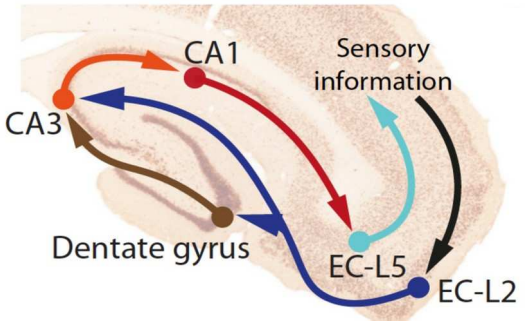
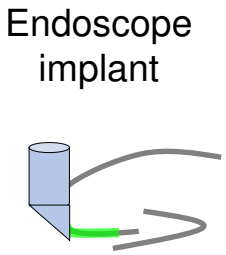
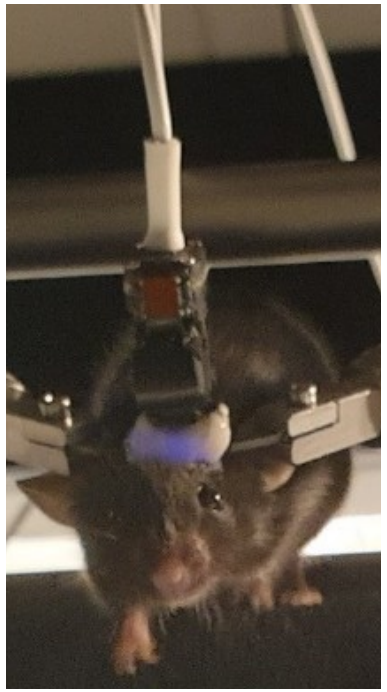
1 Photon imaging, the miniscope







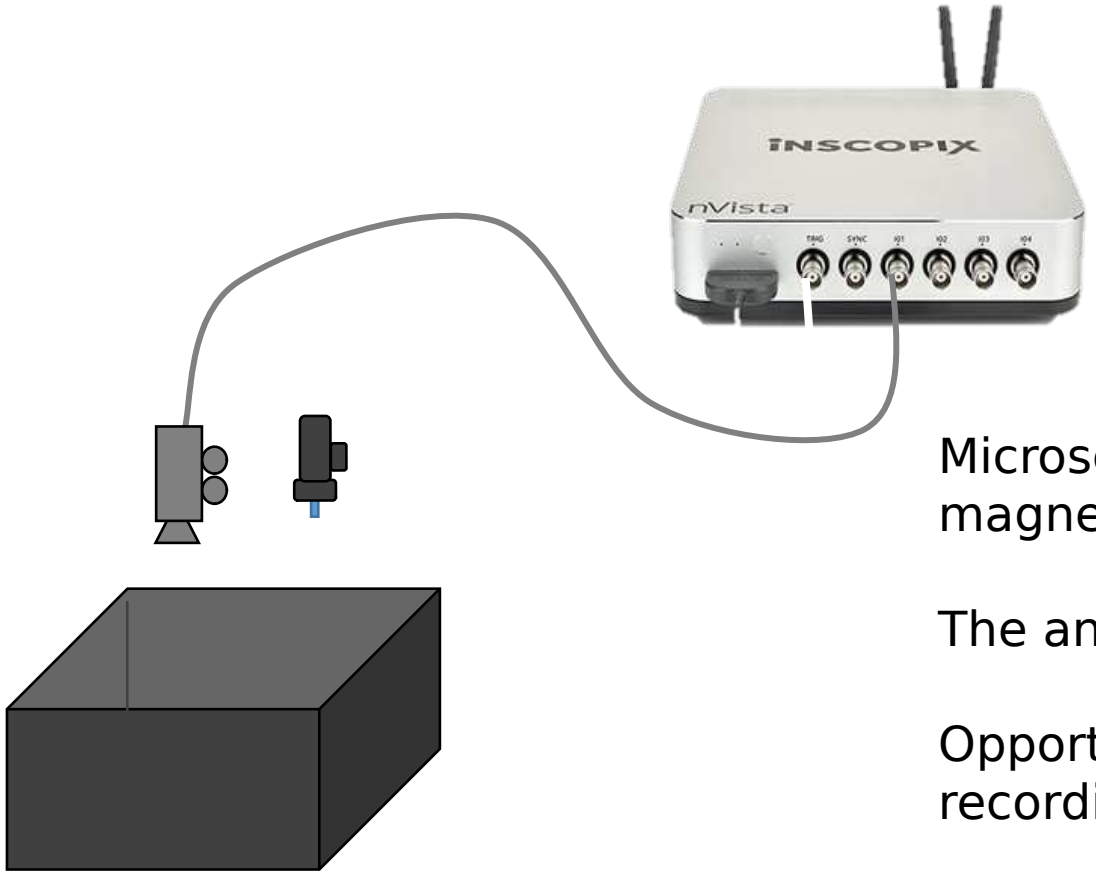
Microscope the size of a thumb attached onto an magnetic plate

The animal has the opportunity to freely move

Opportunity for 2 dimensional behavior during neuronal recording

Data acquisition box ensures synchronization of
- behavioral video recording
- miniscope neuronal recording
- other experimental controller or readouts

1 Photon imaging, the miniscope



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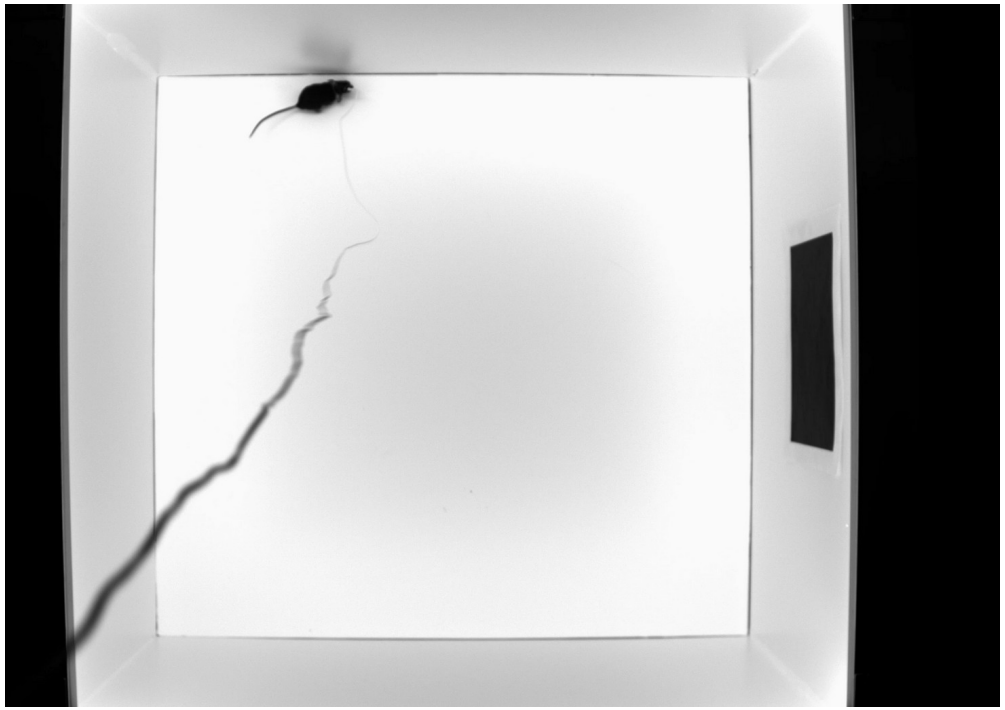
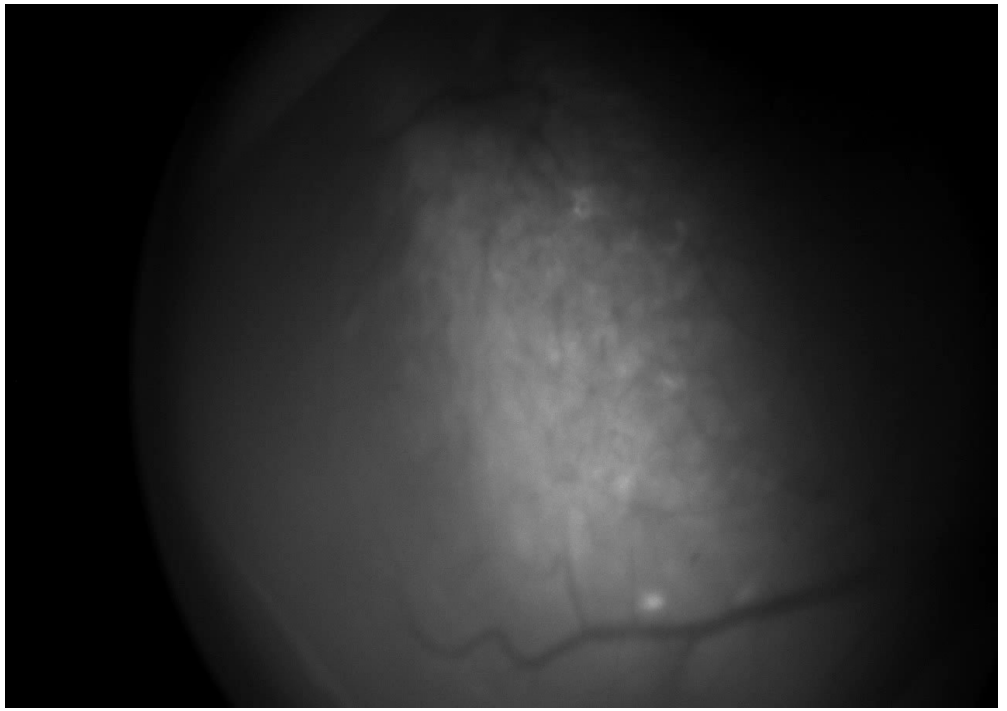
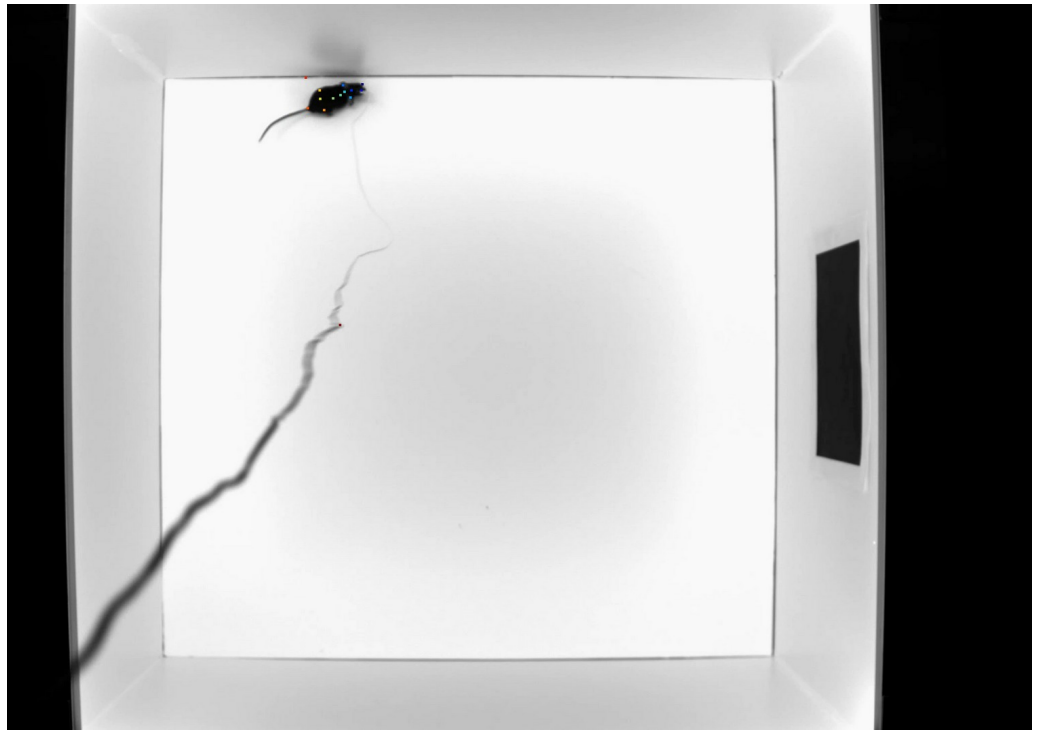
1 Photon imaging, the miniscope





Animal recording and tracking in open arena



DeepLabCut™: a software package for animal pose estimation

Mathis Laboratory of adaptive motor control

Deep computational neuronal network for body part tracking

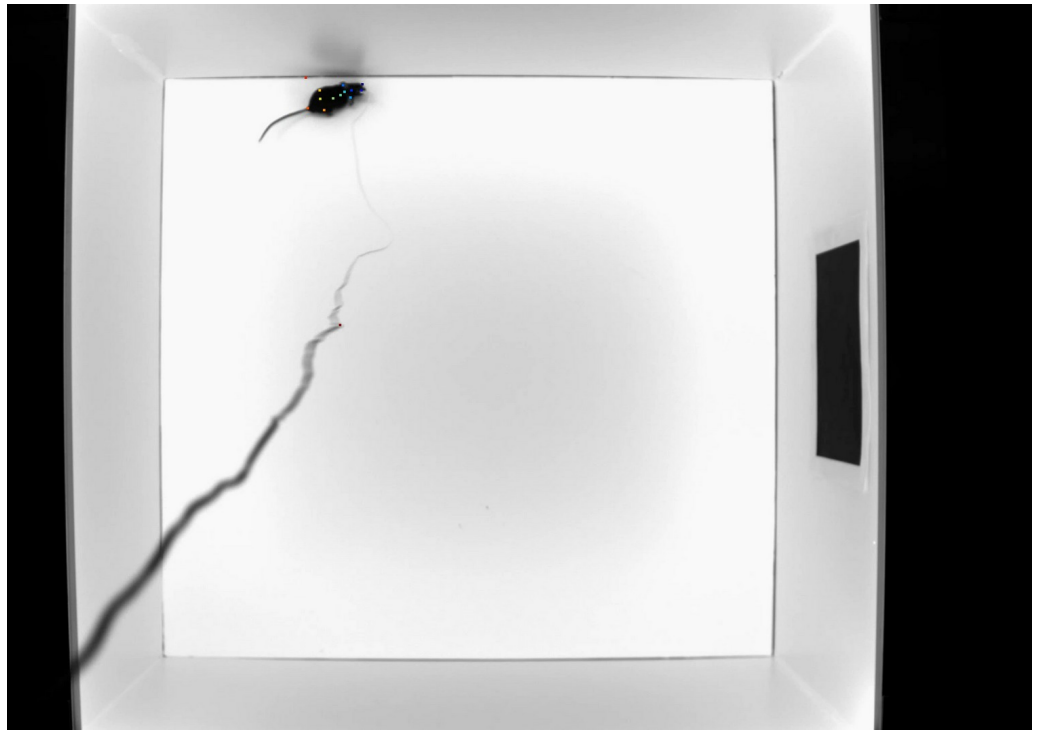
Train DLC neuronal network by marking body parts on ~200 frames manually

The trained neuronal network will then mark the body parts for each frame automatically

How many frames does get labeled ?
30 min per Video with 20 frames per second

30 min * 60 sec * 20 = 36000 frames

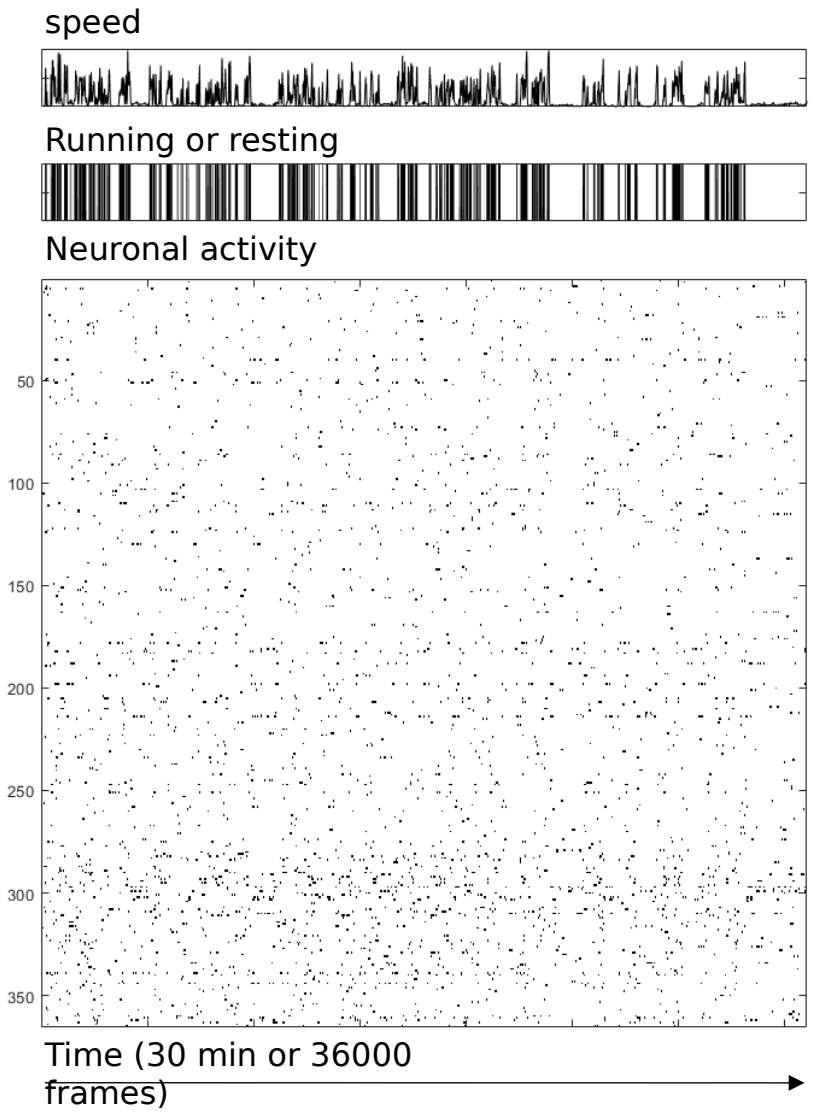
Animal recording and tracking in open arena



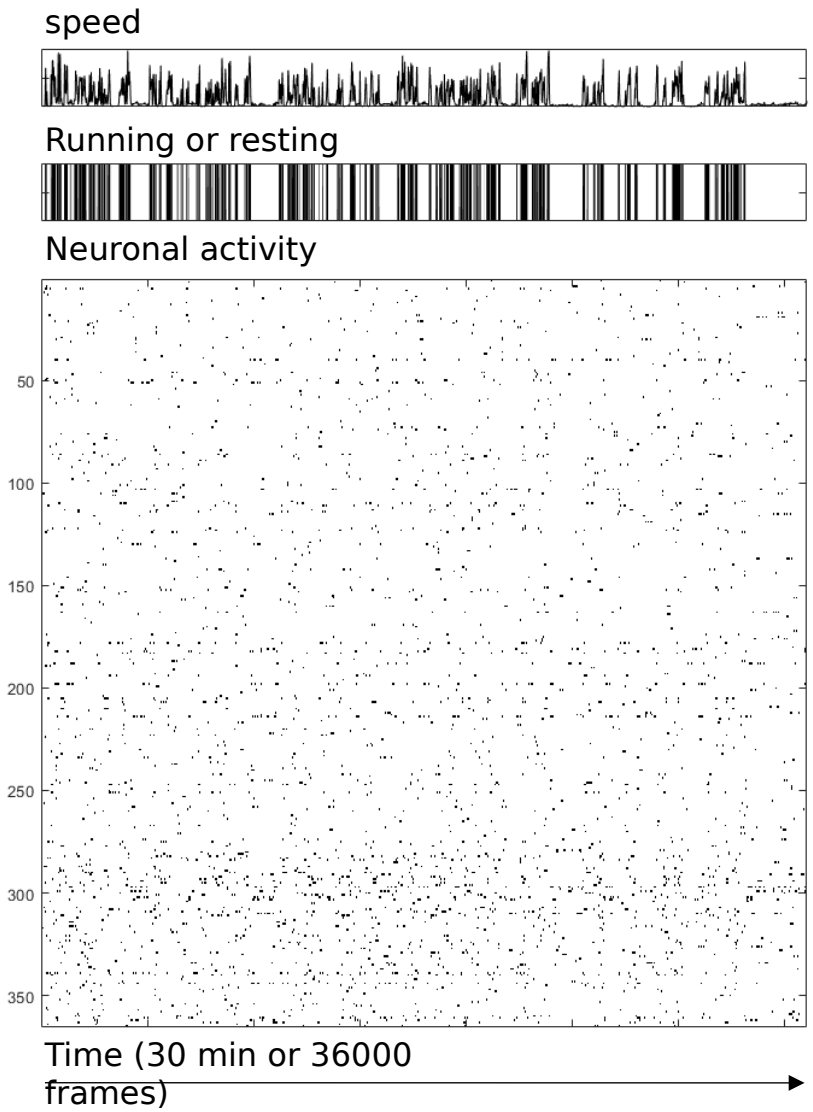
Snout
Miniscope top
Miniscope bottom
Left ear
Right ear
Head/Neck
Shoulders
Body Center
Hip center
Hip left
Hip right
Base tail
Center tail
Tip tail

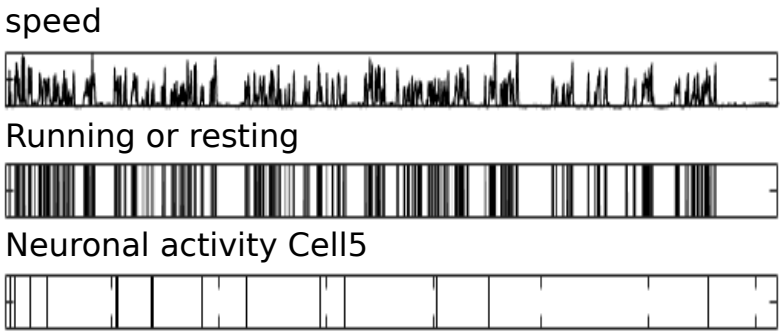
Blow up the mouse

Combining neuronal events with behavior

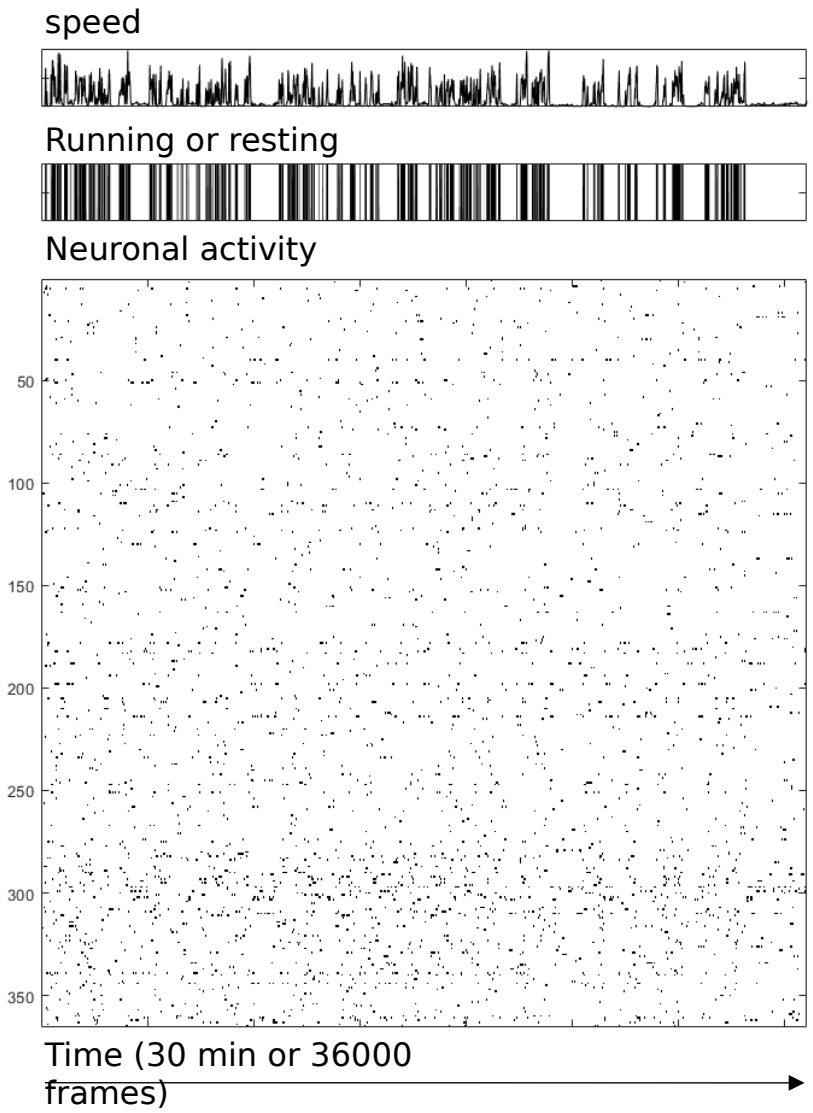


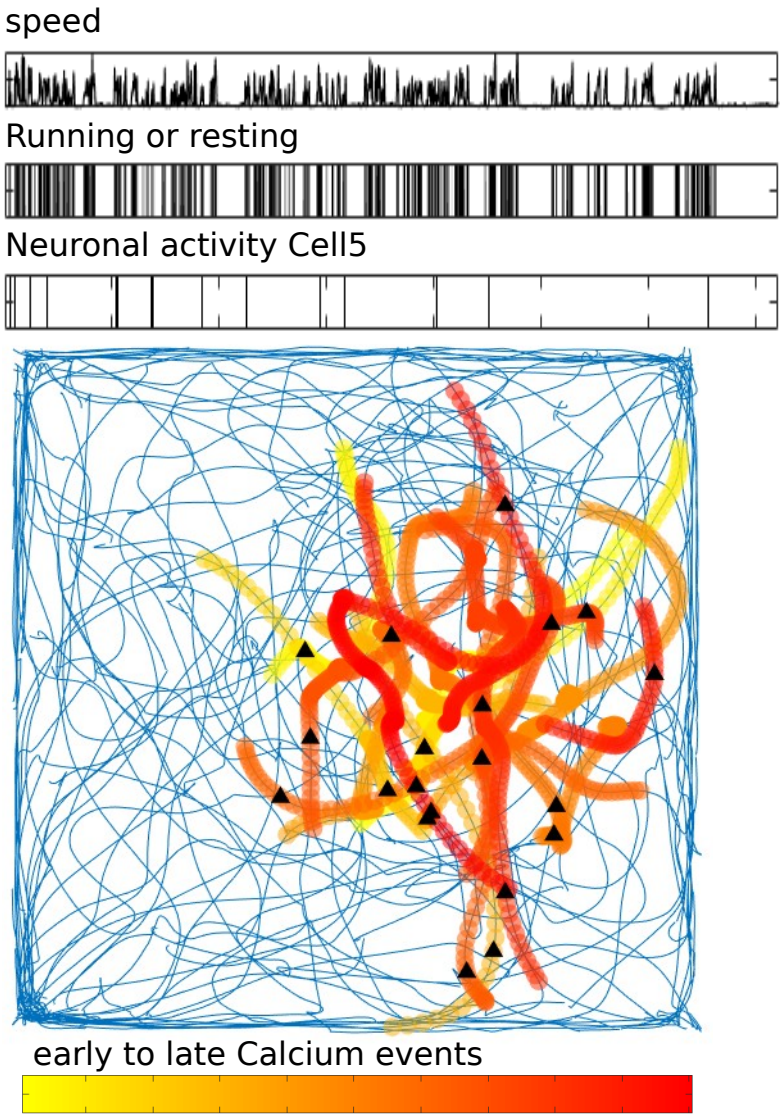
Combining neuronal events with behavior





Combining neuronal events with behavior

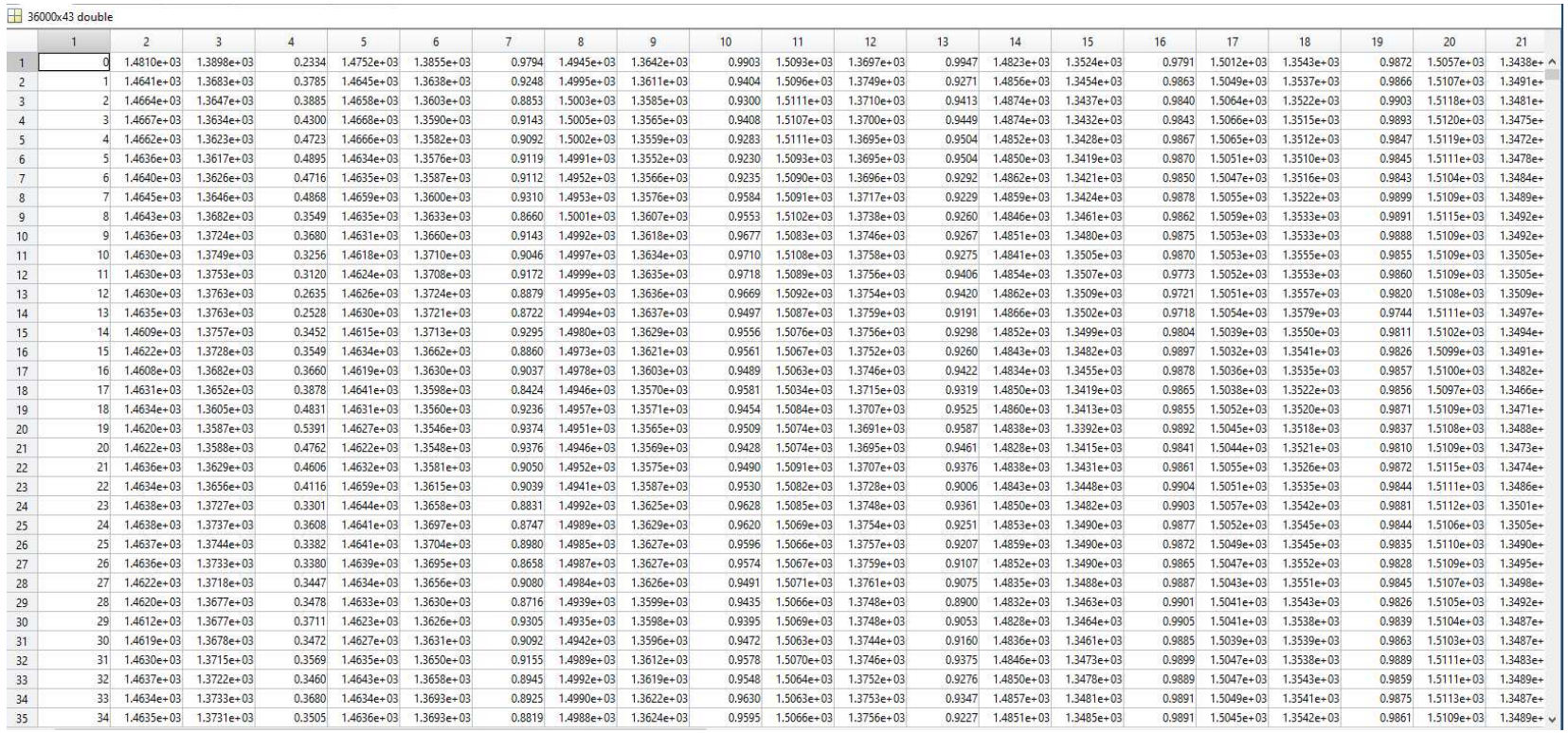




Processing raw data with Matlab to find Place Cells

43 columns

36000 rows



36000x43 double

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
1	0	1.4810e+03	1.3898e+03	0.2334	1.4752e+03	1.3855e+03	0.9794	1.4945e+03	1.3642e+03	0.9903	1.5093e+03	1.3697e+03	0.9947	1.4823e+03	1.3524e+03	0.9791	1.5012e+03	1.3543e+03	0.9872	1.5057e+03	1.3438e+
2	1	1.4641e+03	1.3683e+03	0.3785	1.4645e+03	1.3638e+03	0.9248	1.4995e+03	1.3611e+03	0.9404	1.5096e+03	1.3749e+03	0.9271	1.4856e+03	1.3454e+03	0.9863	1.5049e+03	1.3537e+03	0.9866	1.5107e+03	1.3491e+
3	2	1.4664e+03	1.3647e+03	0.3885	1.4658e+03	1.3603e+03	0.8853	1.5003e+03	1.3585e+03	0.9300	1.5111e+03	1.3710e+03	0.9413	1.4874e+03	1.3437e+03	0.9840	1.5064e+03	1.3522e+03	0.9903	1.5118e+03	1.3481e+
4	3	1.4667e+03	1.3634e+03	0.4300	1.4668e+03	1.3590e+03	0.9143	1.5005e+03	1.3565e+03	0.9408	1.5107e+03	1.3700e+03	0.9449	1.4874e+03	1.3432e+03	0.9843	1.5066e+03	1.3515e+03	0.9893	1.5120e+03	1.3475e+
5	4	1.4662e+03	1.3623e+03	0.4723	1.4666e+03	1.3582e+03	0.9092	1.5002e+03	1.3559e+03	0.9283	1.5111e+03	1.3695e+03	0.9504	1.4852e+03	1.3428e+03	0.9867	1.5065e+03	1.3512e+03	0.9847	1.5119e+03	1.3472e+
6	5	1.4636e+03	1.3617e+03	0.4895	1.4634e+03	1.3576e+03	0.9119	1.4991e+03	1.3552e+03	0.9230	1.5093e+03	1.3695e+03	0.9504	1.4850e+03	1.3419e+03	0.9870	1.5051e+03	1.3510e+03	0.9845	1.5111e+03	1.3478e+
7	6	1.4640e+03	1.3626e+03	0.4716	1.4635e+03	1.3587e+03	0.9112	1.4952e+03	1.3566e+03	0.9235	1.5090e+03	1.3696e+03	0.9292	1.4862e+03	1.3421e+03	0.9850	1.5047e+03	1.3516e+03	0.9843	1.5104e+03	1.3484e+
8	7	1.4645e+03	1.3646e+03	0.4868	1.4659e+03	1.3600e+03	0.9310	1.4953e+03	1.3576e+03	0.9584	1.5091e+03	1.3717e+03	0.9229	1.4859e+03	1.3424e+03	0.9878	1.5055e+03	1.3522e+03	0.9899	1.5109e+03	1.3489e+
9	8	1.4643e+03	1.3682e+03	0.3549	1.4635e+03	1.3633e+03	0.8660	1.5001e+03	1.3607e+03	0.9553	1.5102e+03	1.3738e+03	0.9260	1.4846e+03	1.3461e+03	0.9862	1.5059e+03	1.3533e+03	0.9891	1.5115e+03	1.3492e+
10	9	1.4636e+03	1.3724e+03	0.3680	1.4631e+03	1.3660e+03	0.9143	1.4992e+03	1.3618e+03	0.9677	1.5083e+03	1.3746e+03	0.9267	1.4851e+03	1.3480e+03	0.9875	1.5053e+03	1.3533e+03	0.9888	1.5109e+03	1.3492e+
11	10	1.4630e+03	1.3749e+03	0.3256	1.4618e+03	1.3710e+03	0.9046	1.4997e+03	1.3634e+03	0.9710	1.5108e+03	1.3758e+03	0.9275	1.4841e+03	1.3505e+03	0.9870	1.5053e+03	1.3555e+03	0.9855	1.5109e+03	1.3505e+
12	11	1.4630e+03	1.3753e+03	0.3120	1.4624e+03	1.3708e+03	0.9172	1.4999e+03	1.3635e+03	0.9718	1.5089e+03	1.3756e+03	0.9406	1.4854e+03	1.3507e+03	0.9773	1.5052e+03	1.3553e+03	0.9860	1.5109e+03	1.3505e+
13	12	1.4630e+03	1.3763e+03	0.2635	1.4626e+03	1.3724e+03	0.8879	1.4995e+03	1.3636e+03	0.9669	1.5092e+03	1.3754e+03	0.9420	1.4862e+03	1.3509e+03	0.9721	1.5051e+03	1.3557e+03	0.9820	1.5108e+03	1.3509e+
14	13	1.4635e+03	1.3763e+03	0.2528	1.4630e+03	1.3721e+03	0.8722	1.4994e+03	1.3637e+03	0.9497	1.5087e+03	1.3759e+03	0.9191	1.4866e+03	1.3502e+03	0.9718	1.5054e+03	1.3579e+03	0.9744	1.5111e+03	1.3497e+
15	14	1.4609e+03	1.3757e+03	0.3452	1.4615e+03	1.3713e+03	0.9295	1.4980e+03	1.3629e+03	0.9556	1.5076e+03	1.3756e+03	0.9298	1.4852e+03	1.3499e+03	0.9804	1.5039e+03	1.3550e+03	0.9811	1.5102e+03	1.3494e+
16	15	1.4622e+03	1.3728e+03	0.3549	1.4634e+03	1.3662e+03	0.8860	1.4973e+03	1.3621e+03	0.9561	1.5067e+03	1.3752e+03	0.9260	1.4843e+03	1.3482e+03	0.9897	1.5032e+03	1.3541e+03	0.9826	1.5099e+03	1.3491e+
17	16	1.4608e+03	1.3682e+03	0.3660	1.4619e+03	1.3630e+03	0.9037	1.4978e+03	1.3603e+03	0.9489	1.5063e+03	1.3746e+03	0.9422	1.4834e+03	1.3455e+03	0.9878	1.5036e+03	1.3535e+03	0.9857	1.5100e+03	1.3482e+
18	17	1.4631e+03	1.3652e+03	0.3878	1.4641e+03	1.3598e+03	0.8424	1.4946e+03	1.3570e+03	0.9581	1.5034e+03	1.3715e+03	0.9319	1.4850e+03	1.3419e+03	0.9865	1.5038e+03	1.3522e+03	0.9856	1.5097e+03	1.3466e+
19	18	1.4634e+03	1.3605e+03	0.4831	1.4631e+03	1.3560e+03	0.9236	1.4957e+03	1.3571e+03	0.9454	1.5084e+03	1.3707e+03	0.9525	1.4860e+03	1.3413e+03	0.9855	1.5052e+03	1.3520e+03	0.9871	1.5109e+03	1.3471e+
20	19	1.4620e+03	1.3587e+03	0.5391	1.4627e+03	1.3546e+03	0.9374	1.4951e+03	1.3565e+03	0.9509	1.5074e+03	1.3691e+03	0.9587	1.4838e+03	1.3392e+03	0.9892	1.5045e+03	1.3518e+03	0.9837	1.5108e+03	1.3488e+
21	20	1.4622e+03	1.3588e+03	0.4762	1.4622e+03	1.3548e+03	0.9376	1.4946e+03	1.3569e+03	0.9428	1.5074e+03	1.3695e+03	0.9461	1.4828e+03	1.3415e+03	0.9841	1.5044e+03	1.3521e+03	0.9810	1.5109e+03	1.3473e+
22	21	1.4636e+03	1.3629e+03	0.4606	1.4632e+03	1.3581e+03	0.9050	1.4952e+03	1.3575e+03	0.9490	1.5091e+03	1.3707e+03	0.9376	1.4838e+03	1.3431e+03	0.9861	1.5055e+03	1.3526e+03	0.9872	1.5115e+03	1.3474e+
23	22	1.4634e+03	1.3656e+03	0.4116	1.4659e+03	1.3615e+03	0.9039	1.4941e+03	1.3587e+03	0.9530	1.5082e+03	1.3728e+03	0.9006	1.4843e+03	1.3448e+03	0.9904	1.5051e+03	1.3535e+03	0.9844	1.5111e+03	1.3486e+
24	23	1.4638e+03	1.3727e+03	0.3301	1.4644e+03	1.3658e+03	0.8831	1.4992e+03	1.3625e+03	0.9628	1.5085e+03	1.3748e+03	0.9361	1.4850e+03	1.3482e+03	0.9903	1.5057e+03	1.3542e+03	0.9881	1.5112e+03	1.3501e+
25	24	1.4638e+03	1.3737e+03	0.3608	1.4641e+03	1.3697e+03	0.8747	1.4989e+03	1.3629e+03	0.9620	1.5069e+03	1.3754e+03	0.9251	1.4853e+03	1.3490e+03	0.9877	1.5052e+03	1.3545e+03	0.9844	1.5106e+03	1.3505e+
26	25	1.4637e+03	1.3744e+03	0.3382	1.4641e+03	1.3704e+03	0.8980	1.4985e+03	1.3627e+03	0.9596	1.5066e+03	1.3757e+03	0.9207	1.4859e+03	1.3490e+03	0.9872	1.5049e+03	1.3545e+03	0.9835	1.5110e+03	1.3490e+
27	26	1.4636e+03	1.3733e+03	0.3380	1.4639e+03	1.3695e+03	0.8658	1.4987e+03	1.3627e+03	0.9574	1.5067e+03	1.3759e+03	0.9107	1.4852e+03	1.3490e+03	0.9865	1.5047e+03	1.3552e+03	0.9828	1.5109e+03	1.3495e+
28	27	1.4622e+03	1.3718e+03	0.3447	1.4634e+03	1.3656e+03	0.9080	1.4984e+03	1.3626e+03	0.9491	1.5071e+03	1.3761e+03	0.9075	1.4835e+03	1.3488e+03	0.9887	1.5043e+03	1.3551e+03	0.9845	1.5107e+03	1.3498e+
29	28	1.4620e+03	1.3677e+03	0.3478	1.4633e+03	1.3630e+03	0.8716	1.4939e+03	1.3599e+03	0.9435	1.5066e+03	1.3748e+03	0.8900	1.4832e+03	1.3463e+03	0.9901	1.5041e+03	1.3543e+03	0.9826	1.5105e+03	1.3492e+
30	29	1.4612e+03	1.3677e+03	0.3711	1.4623e+03	1.3626e+03	0.9305	1.4935e+03	1.3598e+03	0.9395	1.5069e+03	1.3748e+03	0.9053	1.4828e+03	1.3464e+03	0.9905	1.5041e+03	1.3538e+03	0.9839	1.5104e+03	1.3487e+
31	30	1.4619e+03	1.3678e+03	0.3472	1.4627e+03	1.3631e+03	0.9092	1.4942e+03	1.3596e+03	0.9472	1.5063e+03	1.3744e+03	0.9160	1.4836e+03	1.3461e+03	0.9885	1.5039e+03	1.3539e+03	0.9863	1.5103e+03	1.3487e+
32	31	1.4630e+03	1.3715e+03	0.3569	1.4635e+03	1.3650e+03	0.9155	1.4989e+03	1.3612e+03	0.9578	1.5070e+03	1.3746e+03	0.9375	1.4846e+03	1.3473e+03	0.9899	1.5047e+03	1.3538e+03	0.9889	1.5111e+03	1.3483e+
33	32	1.4637e+03	1.3722e+03	0.3460	1.4643e+03	1.3658e+03	0.8945	1.4992e+03	1.3619e+03	0.9548	1.5064e+03	1.3752e+03	0.9276	1.4850e+03	1.3478e+03	0.9889	1.5047e+03	1.3543e+03	0.9859	1.5111e+03	1.3489e+
34	33	1.4634e+03	1.3733e+03	0.3680	1.4634e+03	1.3693e+03	0.8925	1.4990e+03	1.3622e+03	0.9630	1.5063e+03	1.3753e+03	0.9347	1.4857e+03	1.3481e+03	0.9891	1.5049e+03	1.3541e+03	0.9875	1.5113e+03	1.3487e+
35	34	1.4635e+03	1.3731e+03	0.3505	1.4636e+03	1.3693e+03	0.8819	1.4988e+03	1.3624e+03	0.9595	1.5066e+03	1.3756e+03	0.9227	1.4851e+03	1.3485e+03	0.9891	1.5045e+03	1.3542e+03	0.9861	1.5109e+03	1.3489e+

Processing raw data with Matlab to find Place Cells

Breaking down raw data

43 columns = coordinates each body part

36000 rows
= frames

36000x43 double

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
1	0	1.4810e+03	1.3898e+03	0.2334	1.4752e+03	1.3855e+03	0.9794	1.4945e+03	1.3642e+03	0.9903	1.5093e+03	1.3697e+03	0.9947	1.4823e+03	1.3524e+03	0.9791	1.5012e+03	1.3543e+03	0.9872	1.5057e+03	1.3438e+
2	1	1.4641e+03	1.3683e+03	0.3785	1.4645e+03	1.3638e+03	0.9248	1.4995e+03	1.3611e+03	0.9404	1.5096e+03	1.3749e+03	0.9271	1.4856e+03	1.3454e+03	0.9863	1.5049e+03	1.3537e+03	0.9866	1.5107e+03	1.3491e+
3	2	1.4664e+03	1.3647e+03	0.3885	1.4658e+03	1.3603e+03	0.8853	1.5003e+03	1.3585e+03	0.9300	1.5111e+03	1.3710e+03	0.9413	1.4874e+03	1.3437e+03	0.9840	1.5064e+03	1.3522e+03	0.9903	1.5118e+03	1.3481e+
4	3	1.4667e+03	1.3634e+03	0.4300	1.4668e+03	1.3590e+03	0.9143	1.5005e+03	1.3565e+03	0.9408	1.5107e+03	1.3700e+03	0.9449	1.4874e+03	1.3432e+03	0.9843	1.5066e+03	1.3515e+03	0.9893	1.5120e+03	1.3475e+
5	4	1.4662e+03	1.3623e+03	0.4723	1.4666e+03	1.3582e+03	0.9092	1.5002e+03	1.3559e+03	0.9283	1.5111e+03	1.3695e+03	0.9504	1.4852e+03	1.3428e+03	0.9867	1.5065e+03	1.3512e+03	0.9847	1.5119e+03	1.3472e+
6	5	1.4636e+03	1.3617e+03	0.4895	1.4634e+03	1.3576e+03	0.9119	1.4991e+03	1.3552e+03	0.9230	1.5093e+03	1.3695e+03	0.9504	1.4850e+03	1.3419e+03	0.9870	1.5051e+03	1.3510e+03	0.9845	1.5111e+03	1.3478e+
7	6	1.4640e+03	1.3626e+03	0.4716	1.4635e+03	1.3587e+03	0.9112	1.4952e+03	1.3566e+03	0.9235	1.5090e+03	1.3696e+03	0.9292	1.4862e+03	1.3421e+03	0.9850	1.5047e+03	1.3516e+03	0.9843	1.5104e+03	1.3484e+
8	7	1.4645e+03	1.3646e+03	0.4868	1.4659e+03	1.3600e+03	0.9310	1.4953e+03	1.3576e+03	0.9584	1.5091e+03	1.3717e+03	0.9229	1.4859e+03	1.3424e+03	0.9878	1.5055e+03	1.3522e+03	0.9899	1.5109e+03	1.3489e+
9	8	1.4643e+03	1.3682e+03	0.3549	1.4635e+03	1.3633e+03	0.8660	1.5001e+03	1.3607e+03	0.9553	1.5102e+03	1.3738e+03	0.9260	1.4846e+03	1.3461e+03	0.9862	1.5059e+03	1.3533e+03	0.9891	1.5115e+03	1.3492e+
10	9	1.4636e+03	1.3724e+03	0.3680	1.4631e+03	1.3660e+03	0.9143	1.4992e+03	1.3618e+03	0.9677	1.5083e+03	1.3746e+03	0.9267	1.4851e+03	1.3480e+03	0.9875	1.5053e+03	1.3533e+03	0.9888	1.5109e+03	1.3492e+
11	10	1.4630e+03	1.3749e+03	0.3256	1.4618e+03	1.3710e+03	0.9046	1.4997e+03	1.3634e+03	0.9710	1.5108e+03	1.3758e+03	0.9275	1.4841e+03	1.3505e+03	0.9870	1.5053e+03	1.3555e+03	0.9855	1.5109e+03	1.3505e+
12	11	1.4630e+03	1.3753e+03	0.3120	1.4624e+03	1.3708e+03	0.9172	1.4999e+03	1.3635e+03	0.9718	1.5089e+03	1.3756e+03	0.9406	1.4854e+03	1.3507e+03	0.9773	1.5052e+03	1.3553e+03	0.9860	1.5109e+03	1.3505e+
13	12	1.4630e+03	1.3763e+03	0.2635	1.4626e+03	1.3724e+03	0.8879	1.4995e+03	1.3636e+03	0.9669	1.5092e+03	1.3754e+03	0.9420	1.4862e+03	1.3509e+03	0.9721	1.5051e+03	1.3557e+03	0.9820	1.5108e+03	1.3509e+
14	13	1.4635e+03	1.3763e+03	0.2528	1.4630e+03	1.3721e+03	0.8722	1.4994e+03	1.3637e+03	0.9497	1.5087e+03	1.3759e+03	0.9191	1.4866e+03	1.3502e+03	0.9718	1.5054e+03	1.3579e+03	0.9744	1.5111e+03	1.3497e+
15	14	1.4609e+03	1.3757e+03	0.3452	1.4615e+03	1.3713e+03	0.9295	1.4980e+03	1.3629e+03	0.9556	1.5076e+03	1.3756e+03	0.9298	1.4852e+03	1.3499e+03	0.9804	1.5039e+03	1.3550e+03	0.9811	1.5102e+03	1.3494e+
16	15	1.4622e+03	1.3728e+03	0.3549	1.4634e+03	1.3662e+03	0.8860	1.4973e+03	1.3621e+03	0.9561	1.5067e+03	1.3752e+03	0.9260	1.4843e+03	1.3482e+03	0.9897	1.5032e+03	1.3541e+03	0.9826	1.5099e+03	1.3491e+
17	16	1.4608e+03	1.3682e+03	0.3660	1.4619e+03	1.3630e+03	0.9037	1.4978e+03	1.3603e+03	0.9489	1.5063e+03	1.3746e+03	0.9422	1.4834e+03	1.3455e+03	0.9878	1.5036e+03	1.3535e+03	0.9857	1.5100e+03	1.3482e+
18	17	1.4631e+03	1.3652e+03	0.3878	1.4641e+03	1.3598e+03	0.8424	1.4946e+03	1.3570e+03	0.9581	1.5034e+03	1.3715e+03	0.9319	1.4850e+03	1.3419e+03	0.9865	1.5038e+03	1.3522e+03	0.9856	1.5097e+03	1.3466e+
19	18	1.4634e+03	1.3605e+03	0.4831	1.4631e+03	1.3560e+03	0.9236	1.4957e+03	1.3571e+03	0.9454	1.5084e+03	1.3707e+03	0.9525	1.4860e+03	1.3413e+03	0.9855	1.5052e+03	1.3520e+03	0.9871	1.5109e+03	1.3471e+
20	19	1.4620e+03	1.3587e+03	0.5391	1.4627e+03	1.3546e+03	0.9374	1.4951e+03	1.3565e+03	0.9509	1.5074e+03	1.3691e+03	0.9587	1.4838e+03	1.3392e+03	0.9892	1.5045e+03	1.3518e+03	0.9837	1.5108e+03	1.3488e+
21	20	1.4622e+03	1.3588e+03	0.4762	1.4622e+03	1.3548e+03	0.9376	1.4946e+03	1.3569e+03	0.9428	1.5074e+03	1.3695e+03	0.9461	1.4828e+03	1.3415e+03	0.9841	1.5044e+03	1.3521e+03	0.9810	1.5109e+03	1.3473e+
22	21	1.4636e+03	1.3629e+03	0.4606	1.4632e+03	1.3581e+03	0.9050	1.4952e+03	1.3575e+03	0.9490	1.5091e+03	1.3707e+03	0.9376	1.4838e+03	1.3431e+03	0.9861	1.5055e+03	1.3526e+03	0.9872	1.5115e+03	1.3474e+
23	22	1.4634e+03	1.3656e+03	0.4116	1.4659e+03	1.3615e+03	0.9039	1.4941e+03	1.3587e+03	0.9530	1.5082e+03	1.3728e+03	0.9006	1.4843e+03	1.3448e+03	0.9904	1.5051e+03	1.3535e+03	0.9844	1.5111e+03	1.3486e+
24	23	1.4638e+03	1.3727e+03	0.3301	1.4644e+03	1.3658e+03	0.8831	1.4992e+03	1.3625e+03	0.9628	1.5085e+03	1.3748e+03	0.9361	1.4850e+03	1.3482e+03	0.9903	1.5057e+03	1.3542e+03	0.9881	1.5112e+03	1.3501e+
25	24	1.4638e+03	1.3737e+03	0.3608	1.4641e+03	1.3697e+03	0.8747	1.4989e+03	1.3629e+03	0.9620	1.5069e+03	1.3754e+03	0.9251	1.4853e+03	1.3490e+03	0.9877	1.5052e+03	1.3545e+03	0.9844	1.5106e+03	1.3505e+
26	25	1.4637e+03	1.3744e+03	0.3382	1.4641e+03	1.3704e+03	0.8980	1.4985e+03	1.3627e+03	0.9596	1.5066e+03	1.3757e+03	0.9207	1.4859e+03	1.3490e+03	0.9872	1.5049e+03	1.3545e+03	0.9835	1.5110e+03	1.3490e+
27	26	1.4636e+03	1.3733e+03	0.3380	1.4639e+03	1.3695e+03	0.8658	1.4987e+03	1.3627e+03	0.9574	1.5067e+03	1.3759e+03	0.9107	1.4852e+03	1.3490e+03	0.9865	1.5047e+03	1.3552e+03	0.9828	1.5109e+03	1.3495e+
28	27	1.4622e+03	1.3718e+03	0.3447	1.4634e+03	1.3656e+03	0.9080	1.4984e+03	1.3626e+03	0.9491	1.5071e+03	1.3761e+03	0.9075	1.4835e+03	1.3488e+03	0.9887	1.5043e+03	1.3551e+03	0.9845	1.5107e+03	1.3498e+
29	28	1.4620e+03	1.3677e+03	0.3478	1.4633e+03	1.3630e+03	0.8716	1.4939e+03	1.3599e+03	0.9435	1.5066e+03	1.3748e+03	0.8900	1.4832e+03	1.3463e+03	0.9901	1.5041e+03	1.3543e+03	0.9826	1.5105e+03	1.3492e+
30	29	1.4612e+03	1.3677e+03	0.3711	1.4623e+03	1.3626e+03	0.9305	1.4935e+03	1.3598e+03	0.9395	1.5069e+03	1.3748e+03	0.9053	1.4828e+03	1.3464e+03	0.9905	1.5041e+03	1.3538e+03	0.9839	1.5104e+03	1.3487e+
31	30	1.4619e+03	1.3678e+03	0.3472	1.4627e+03	1.3631e+03	0.9092	1.4942e+03	1.3596e+03	0.9472	1.5063e+03	1.3744e+03	0.9160	1.4836e+03	1.3461e+03	0.9885	1.5039e+03	1.3539e+03	0.9863	1.5103e+03	1.3487e+
32	31	1.4630e+03	1.3715e+03	0.3569	1.4635e+03	1.3650e+03	0.9155	1.4989e+03	1.3612e+03	0.9578	1.5070e+03	1.3746e+03	0.9375	1.4846e+03	1.3473e+03	0.9899	1.5047e+03	1.3538e+03	0.9889	1.5111e+03	1.3483e+
33	32	1.4637e+03	1.3722e+03	0.3460	1.4643e+03	1.3658e+03	0.8945	1.4992e+03	1.3619e+03	0.9548	1.5064e+03	1.3752e+03	0.9276	1.4850e+03	1.3478e+03	0.9889	1.5047e+03	1.3543e+03	0.9859	1.5111e+03	1.3489e+
34	33	1.4634e+03	1.3733e+03	0.3680	1.4634e+03	1.3693e+03	0.8925	1.4990e+03	1.3622e+03	0.9630	1.5063e+03	1.3753e+03	0.9347	1.4857e+03	1.3481e+03	0.9891	1.5049e+03	1.3541e+03	0.9875	1.5113e+03	1.3487e+
35	34	1.4635e+03	1.3731e+03	0.3505	1.4636e+03	1.3693e+03	0.8819	1.4988e+03	1.3624e+03	0.9595	1.5066e+03	1.3756e+03	0.9227	1.4851e+03	1.3485e+03	0.9891	1.5045e+03	1.3542e+03	0.9861	1.5109e+03	1.3489e+

Snout
Miniscope top
Miniscope bottom
Left ear
Right ear
Head/Neck
Shoulders
Body Center
Hip center
Hip left
Hip right
Base tail
Center tail
Tip tail

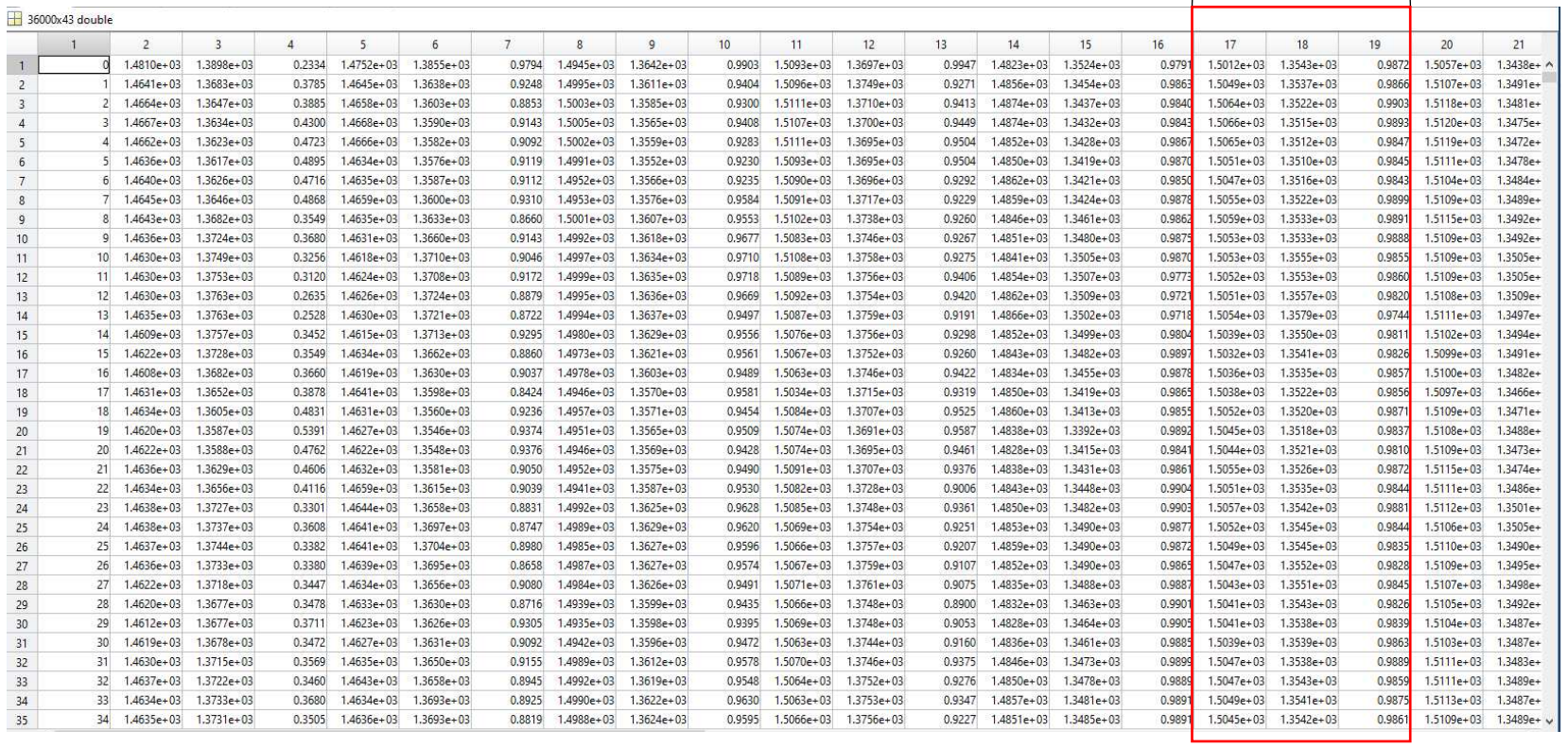
Processing raw data with Matlab to find Place Cells

Breaking down raw data

36000 rows
= frames

43 columns = coordinates each body part

head/neck coordinates
17 – X-direction
18 – Y-direction
19 – reliability estimator (was the tracking any good)

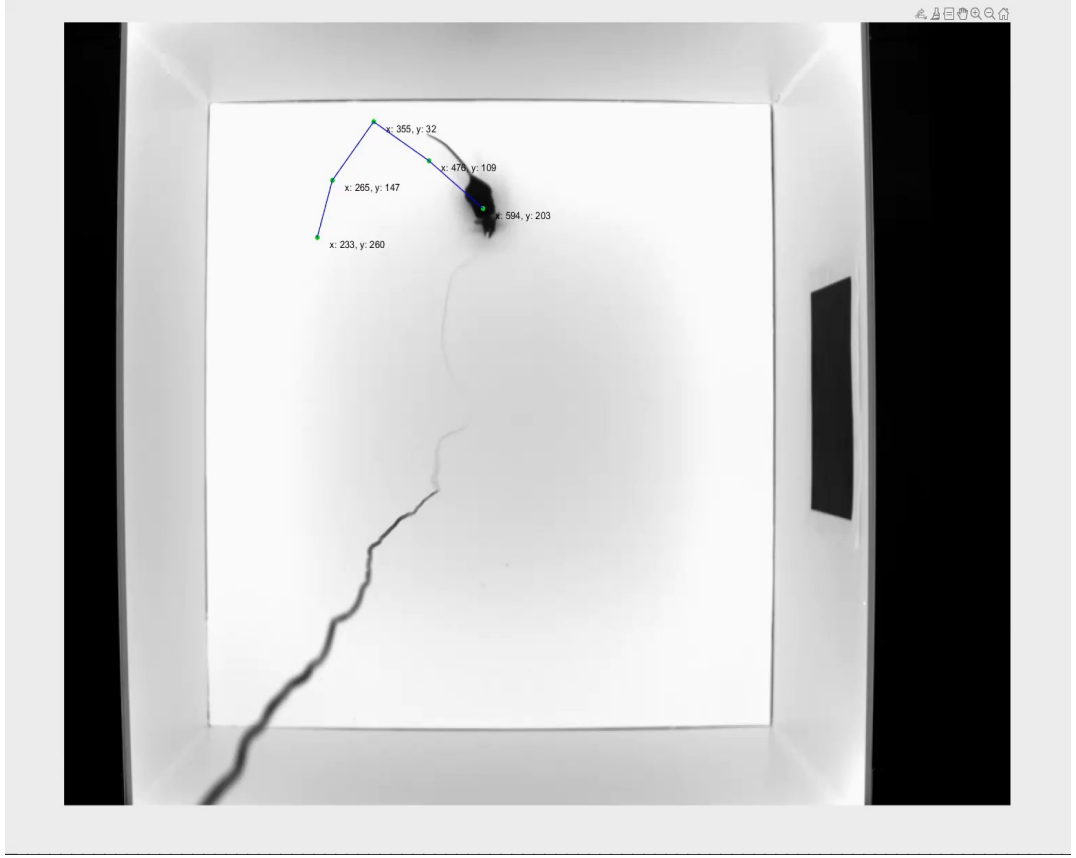


36000x43 double

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
1	0	1.4810e+03	1.3898e+03	0.2334	1.4752e+03	1.3855e+03	0.9794	1.4945e+03	1.3642e+03	0.9903	1.5093e+03	1.3697e+03	0.9947	1.4823e+03	1.3524e+03	0.9791	1.5012e+03	1.3543e+03	0.9872	1.5057e+03	1.3438e+
2	1	1.4641e+03	1.3683e+03	0.3785	1.4645e+03	1.3638e+03	0.9248	1.4995e+03	1.3611e+03	0.9404	1.5096e+03	1.3749e+03	0.9271	1.4856e+03	1.3454e+03	0.9863	1.5049e+03	1.3537e+03	0.9866	1.5107e+03	1.3491e+
3	2	1.4664e+03	1.3647e+03	0.3885	1.4658e+03	1.3603e+03	0.8853	1.5003e+03	1.3585e+03	0.9300	1.5111e+03	1.3710e+03	0.9413	1.4874e+03	1.3437e+03	0.9840	1.5064e+03	1.3522e+03	0.9903	1.5118e+03	1.3481e+
4	3	1.4667e+03	1.3634e+03	0.4300	1.4668e+03	1.3590e+03	0.9143	1.5005e+03	1.3565e+03	0.9408	1.5107e+03	1.3700e+03	0.9449	1.4874e+03	1.3432e+03	0.9843	1.5066e+03	1.3515e+03	0.9893	1.5120e+03	1.3475e+
5	4	1.4662e+03	1.3623e+03	0.4723	1.4666e+03	1.3582e+03	0.9092	1.5002e+03	1.3559e+03	0.9283	1.5111e+03	1.3695e+03	0.9504	1.4852e+03	1.3428e+03	0.9867	1.5065e+03	1.3512e+03	0.9847	1.5119e+03	1.3472e+
6	5	1.4636e+03	1.3617e+03	0.4895	1.4634e+03	1.3576e+03	0.9119	1.4991e+03	1.3552e+03	0.9230	1.5093e+03	1.3695e+03	0.9504	1.4850e+03	1.3419e+03	0.9870	1.5051e+03	1.3510e+03	0.9845	1.5111e+03	1.3478e+
7	6	1.4640e+03	1.3626e+03	0.4716	1.4635e+03	1.3587e+03	0.9112	1.4952e+03	1.3566e+03	0.9235	1.5090e+03	1.3696e+03	0.9292	1.4862e+03	1.3421e+03	0.9850	1.5047e+03	1.3516e+03	0.9843	1.5104e+03	1.3484e+
8	7	1.4645e+03	1.3646e+03	0.4868	1.4659e+03	1.3600e+03	0.9310	1.4953e+03	1.3576e+03	0.9584	1.5091e+03	1.3717e+03	0.9229	1.4859e+03	1.3424e+03	0.9878	1.5055e+03	1.3522e+03	0.9899	1.5109e+03	1.3489e+
9	8	1.4643e+03	1.3682e+03	0.3549	1.4635e+03	1.3633e+03	0.8660	1.5001e+03	1.3607e+03	0.9553	1.5102e+03	1.3738e+03	0.9260	1.4846e+03	1.3461e+03	0.9862	1.5059e+03	1.3533e+03	0.9891	1.5115e+03	1.3492e+
10	9	1.4636e+03	1.3724e+03	0.3680	1.4631e+03	1.3660e+03	0.9143	1.4992e+03	1.3618e+03	0.9677	1.5083e+03	1.3746e+03	0.9267	1.4851e+03	1.3480e+03	0.9875	1.5053e+03	1.3533e+03	0.9888	1.5109e+03	1.3492e+
11	10	1.4630e+03	1.3749e+03	0.3256	1.4618e+03	1.3710e+03	0.9046	1.4997e+03	1.3634e+03	0.9710	1.5108e+03	1.3758e+03	0.9275	1.4841e+03	1.3505e+03	0.9870	1.5053e+03	1.3555e+03	0.9855	1.5109e+03	1.3505e+
12	11	1.4630e+03	1.3753e+03	0.3120	1.4624e+03	1.3708e+03	0.9172	1.4999e+03	1.3635e+03	0.9718	1.5089e+03	1.3756e+03	0.9406	1.4854e+03	1.3507e+03	0.9773	1.5052e+03	1.3553e+03	0.9860	1.5109e+03	1.3505e+
13	12	1.4630e+03	1.3763e+03	0.2635	1.4626e+03	1.3724e+03	0.8879	1.4995e+03	1.3636e+03	0.9669	1.5092e+03	1.3754e+03	0.9420	1.4862e+03	1.3509e+03	0.9721	1.5051e+03	1.3557e+03	0.9820	1.5108e+03	1.3509e+
14	13	1.4635e+03	1.3763e+03	0.2528	1.4630e+03	1.3721e+03	0.8722	1.4994e+03	1.3637e+03	0.9497	1.5087e+03	1.3759e+03	0.9191	1.4866e+03	1.3502e+03	0.9718	1.5054e+03	1.3579e+03	0.9744	1.5111e+03	1.3497e+
15	14	1.4609e+03	1.3757e+03	0.3452	1.4615e+03	1.3713e+03	0.9295	1.4980e+03	1.3629e+03	0.9556	1.5076e+03	1.3756e+03	0.9298	1.4852e+03	1.3499e+03	0.9804	1.5039e+03	1.3550e+03	0.9811	1.5102e+03	1.3494e+
16	15	1.4622e+03	1.3728e+03	0.3549	1.4634e+03	1.3662e+03	0.8860	1.4973e+03	1.3621e+03	0.9561	1.5067e+03	1.3752e+03	0.9260	1.4843e+03	1.3482e+03	0.9897	1.5032e+03	1.3541e+03	0.9826	1.5099e+03	1.3491e+
17	16	1.4608e+03	1.3682e+03	0.3660	1.4619e+03	1.3630e+03	0.9037	1.4978e+03	1.3603e+03	0.9489	1.5063e+03	1.3746e+03	0.9422	1.4834e+03	1.3455e+03	0.9878	1.5036e+03	1.3535e+03	0.9857	1.5100e+03	1.3482e+
18	17	1.4631e+03	1.3652e+03	0.3878	1.4641e+03	1.3598e+03	0.8424	1.4946e+03	1.3570e+03	0.9581	1.5034e+03	1.3715e+03	0.9319	1.4850e+03	1.3419e+03	0.9865	1.5038e+03	1.3522e+03	0.9856	1.5097e+03	1.3466e+
19	18	1.4634e+03	1.3605e+03	0.4831	1.4631e+03	1.3560e+03	0.9236	1.4957e+03	1.3571e+03	0.9454	1.5084e+03	1.3707e+03	0.9525	1.4860e+03	1.3413e+03	0.9859	1.5052e+03	1.3520e+03	0.9871	1.5109e+03	1.3471e+
20	19	1.4620e+03	1.3587e+03	0.5391	1.4627e+03	1.3546e+03	0.9374	1.4951e+03	1.3565e+03	0.9509	1.5074e+03	1.3691e+03	0.9587	1.4838e+03	1.3392e+03	0.9892	1.5045e+03	1.3518e+03	0.9837	1.5108e+03	1.3488e+
21	20	1.4622e+03	1.3588e+03	0.4762	1.4622e+03	1.3548e+03	0.9376	1.4946e+03	1.3569e+03	0.9428	1.5074e+03	1.3695e+03	0.9461	1.4828e+03	1.3415e+03	0.9841	1.5044e+03	1.3521e+03	0.9810	1.5109e+03	1.3473e+
22	21	1.4636e+03	1.3629e+03	0.4606	1.4632e+03	1.3581e+03	0.9050	1.4952e+03	1.3575e+03	0.9490	1.5091e+03	1.3707e+03	0.9376	1.4838e+03	1.3431e+03	0.9861	1.5055e+03	1.3526e+03	0.9872	1.5115e+03	1.3474e+
23	22	1.4634e+03	1.3656e+03	0.4116	1.4659e+03	1.3615e+03	0.9039	1.4941e+03	1.3587e+03	0.9530	1.5082e+03	1.3728e+03	0.9006	1.4843e+03	1.3448e+03	0.9904	1.5051e+03	1.3535e+03	0.9844	1.5111e+03	1.3486e+
24	23	1.4638e+03	1.3727e+03	0.3301	1.4644e+03	1.3658e+03	0.8831	1.4992e+03	1.3625e+03	0.9628	1.5085e+03	1.3748e+03	0.9361	1.4850e+03	1.3482e+03	0.9903	1.5057e+03	1.3542e+03	0.9881	1.5112e+03	1.3501e+
25	24	1.4638e+03	1.3737e+03	0.3608	1.4641e+03	1.3697e+03	0.8747	1.4989e+03	1.3629e+03	0.9620	1.5069e+03	1.3754e+03	0.9251	1.4853e+03	1.3490e+03	0.9877	1.5052e+03	1.3545e+03	0.9844	1.5106e+03	1.3505e+
26	25	1.4637e+03	1.3744e+03	0.3382	1.4641e+03	1.3704e+03	0.8980	1.4985e+03	1.3627e+03	0.9596	1.5066e+03	1.3757e+03	0.9207	1.4859e+03	1.3490e+03	0.9872	1.5049e+03	1.3545e+03	0.9835	1.5110e+03	1.3490e+
27	26	1.4636e+03	1.3733e+03	0.3380	1.4639e+03	1.3695e+03	0.8658	1.4987e+03	1.3627e+03	0.9574	1.5067e+03	1.3759e+03	0.9107	1.4852e+03	1.3490e+03	0.9865	1.5047e+03	1.3552e+03	0.9828	1.5109e+03	1.3495e+
28	27	1.4622e+03	1.3718e+03	0.3447	1.4634e+03	1.3656e+03	0.9080	1.4984e+03	1.3626e+03	0.9491	1.5071e+03	1.3761e+03	0.9075	1.4835e+03	1.3488e+03	0.9887	1.5043e+03	1.3551e+03	0.9845	1.5107e+03	1.3498e+
29	28	1.4620e+03	1.3677e+03	0.3478	1.4633e+03	1.3630e+03	0.8716	1.4939e+03	1.3599e+03	0.9435	1.5066e+03	1.3748e+03	0.8900	1.4832e+03	1.3463e+03	0.9901	1.5041e+03	1.3543e+03	0.9826	1.5105e+03	1.3492e+
30	29	1.4612e+03	1.3677e+03	0.3711	1.4623e+03	1.3626e+03	0.9305	1.4935e+03	1.3598e+03	0.9395	1.5069e+03	1.3748e+03	0.9053	1.4828e+03	1.3464e+03	0.9905	1.5041e+03	1.3538e+03	0.9839	1.5104e+03	1.3487e+
31	30	1.4619e+03	1.3678e+03	0.3472	1.4627e+03	1.3631e+03	0.9092	1.4942e+03	1.3596e+03	0.9472	1.5063e+03	1.3744e+03	0.9160	1.4836e+03	1.3461e+03	0.9885	1.5039e+03	1.3539e+03	0.9863	1.5103e+03	1.3487e+
32	31	1.4630e+03	1.3715e+03	0.3569	1.4635e+03	1.3650e+03	0.9155	1.4989e+03	1.3612e+03	0.9578	1.5070e+03	1.3746e+03	0.9375	1.4846e+03	1.3473e+03	0.9899	1.5047e+03	1.3538e+03	0.9889	1.5111e+03	1.3483e+
33	32	1.4637e+03	1.3722e+03	0.3460	1.4643e+03	1.3658e+03	0.8945	1.4992e+03	1.3619e+03	0.9548	1.5064e+03	1.3752e+03	0.9276	1.4850e+03	1.3478e+03	0.9889	1.5047e+03	1.3543e+03	0.9859	1.5111e+03	1.3489e+
34	33	1.4634e+03	1.3733e+03	0.3680	1.4634e+03	1.3693e+03	0.8925	1.4990e+03	1.3622e+03	0.9630	1.5063e+03	1.3753e+03	0.9347	1.4857e+03	1.3481e+03	0.9891	1.5049e+03	1.3541e+03	0.9875	1.5113e+03	1.3487e+
35	34	1.4635e+03	1.3731e+03	0.3505	1.4636e+03	1.3693e+03	0.8819	1.4988e+03	1.3624e+03	0.9595	1.5066e+03	1.3756e+03	0.9227	1.4851e+03	1.3485e+03	0.9891	1.5045e+03	1.3542e+03	0.9861	1.5109e+03	1.3489e+

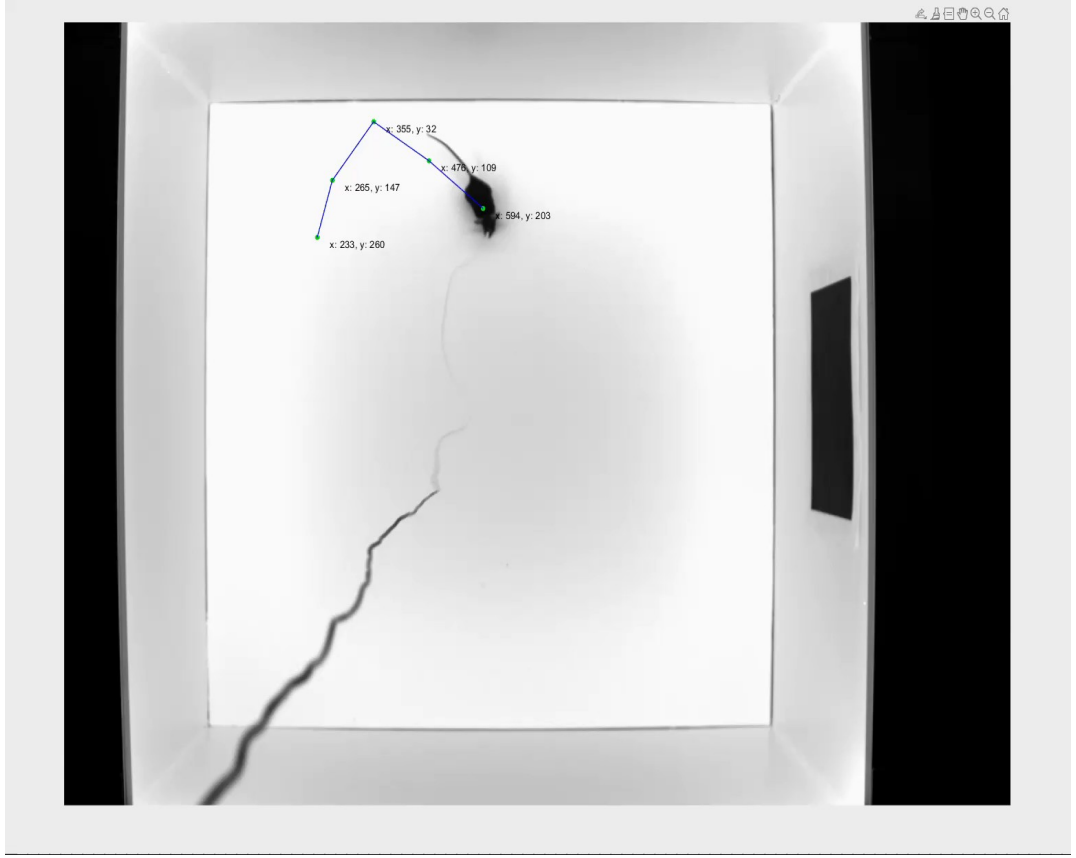
Snout
Miniscope top
Miniscope bottom
Left ear
Right ear
Head/Neck
Shoulders
Body Center
Hip center
Hip left
Hip right
Base tail
Center tail
Tip tail

Processing raw data with Matlab to find Place Cells



sec: 1, x: 233, y: 260, estimator: 0.976
sec: 2, x: 265, y: 147, estimator: 0.971
sec: 3, x: 355, y: 32, estimator: 0.949
sec: 4, x: 476, y: 109, estimator: 0.976
sec: 5, x: 594, y: 203, estimator: 0.986
sec: 6, x: 661, y: 434, estimator: 0.989
sec: 7, x: 545, y: 564, estimator: 0.974
sec: 8, x: 400, y: 640, estimator: 0.815
sec: 9, x: 237, y: 646, estimator: 0.939
sec: 10, x: 92, y: 441, estimator: 0.987
sec: 11, x: 51, y: 265, estimator: 0.991

Processing raw data with Matlab to find Place Cells



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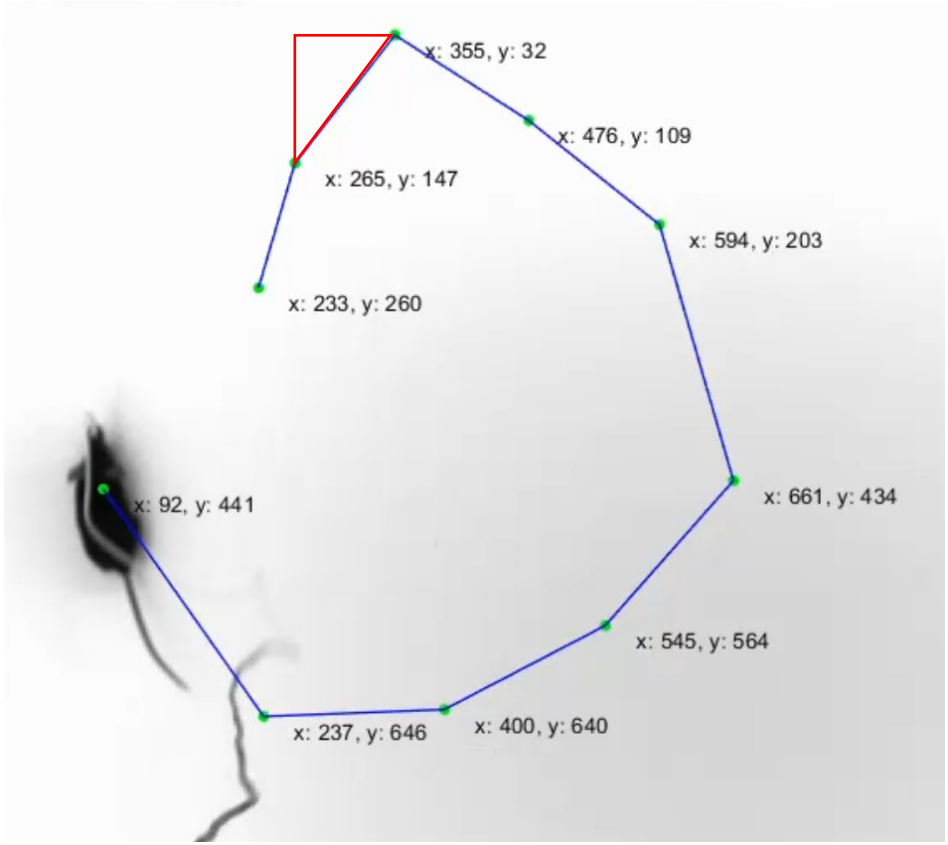
sec: 3, x: 355, y: 32, estimator: 0.949
sec: 4, x: 476, y: 109, estimator: 0.976
sec: 5, x: 594, y: 203, estimator: 0.986
sec: 6, x: 661, y: 434, estimator: 0.989
sec: 7, x: 545, y: 564, estimator: 0.974
sec: 8, x: 400, y: 640, estimator: 0.815
sec: 9, x: 237, y: 646, estimator: 0.939
sec: 10, x: 92, y: 441, estimator: 0.987
sec: 11, x: 51, y: 265, estimator: 0.991

1 Task:
using the estimator to find the most promising body part to plot the trajectory

- Index raw matrix to create a matrix that contains the estimator values only
- Find a math/statistical operator to find the best body part to track
- Draw correct X- and Y-coordinates from raw matrix
- Plot the running trajectory

Processing raw data with Matlab to find Place Cells



sec: 1, x: 233, y: 260, estimator: 0.976
sec: 2, x: 265, y: 147, estimator: 0.971
sec: 3, x: 355, y: 32, estimator: 0.949
sec: 4, x: 476, y: 109, estimator: 0.976
sec: 5, x: 594, y: 203, estimator: 0.986
sec: 6, x: 661, y: 434, estimator: 0.989
sec: 7, x: 545, y: 564, estimator: 0.974
sec: 8, x: 400, y: 640, estimator: 0.815
sec: 9, x: 237, y: 646, estimator: 0.939
sec: 10, x: 92, y: 441, estimator: 0.987
sec: 11, x: 51, y: 265, estimator: 0.991

Distance $c = \sqrt{a^2 + b^2}$

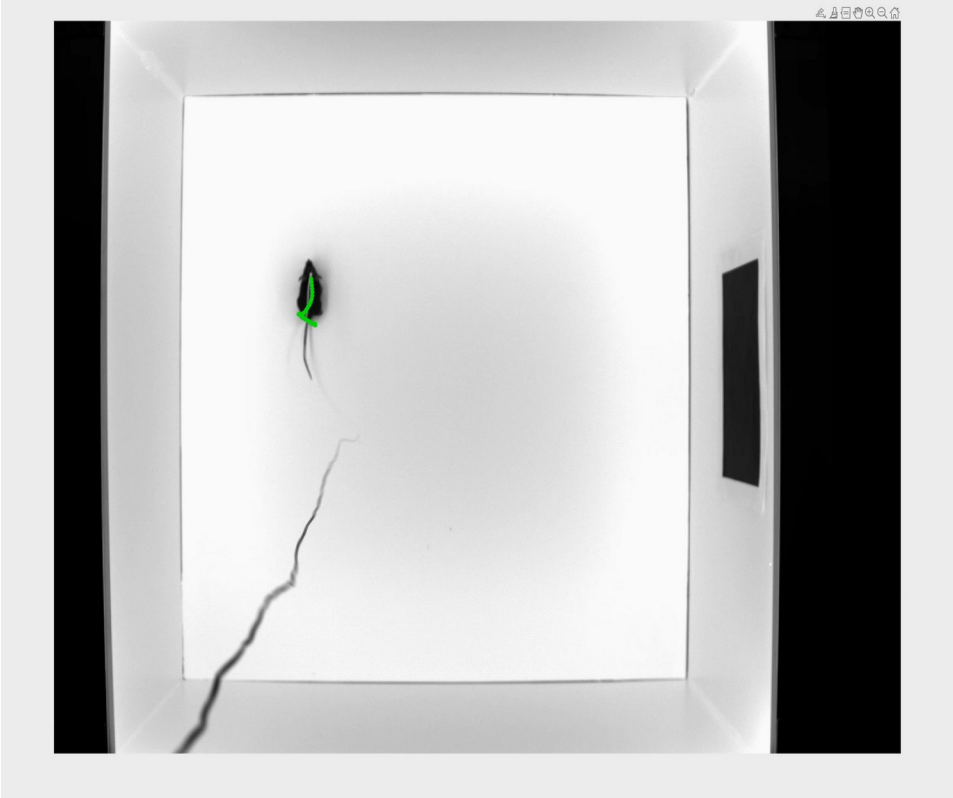
.

Distance/time = speed

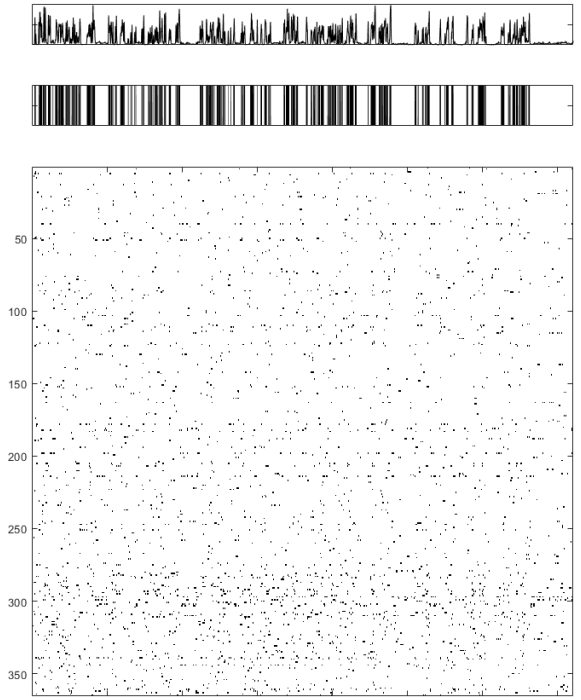
2 Task:
using the correct body part to calculate the speed of the animal and the total distance travels

- Adjust coordinates for better plotting (find point (0|0) and use moving mean)
- Find the size of the arena in pixel and convert it in cm
- Find the distance traveled in per frame
- Calculate the animals speed

Processing raw data with Matlab to find Place Cells



2 x speed

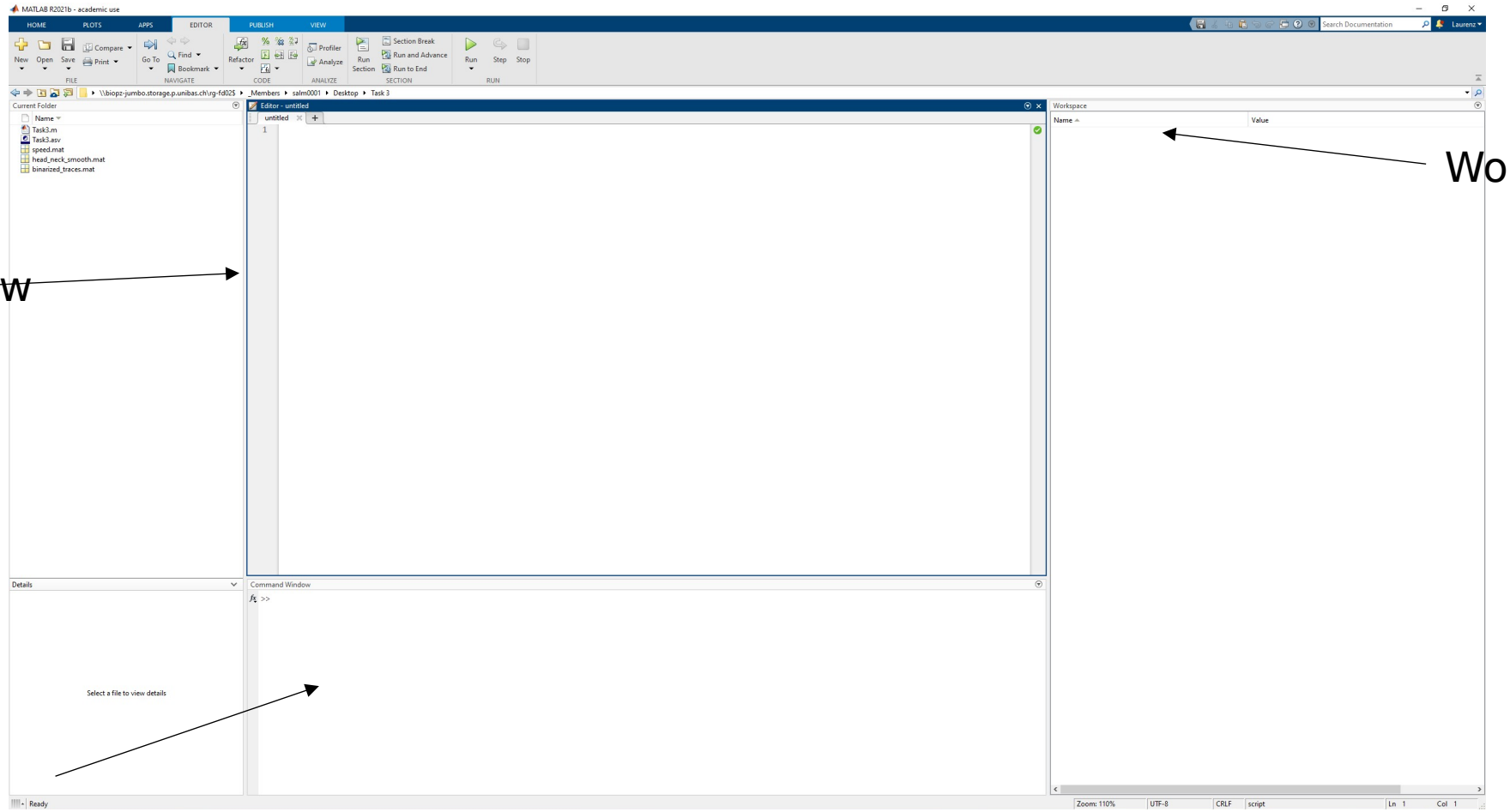


3 Task:
Track the animals behavior, read out neuronal data to the animals behavior and plot single neuron activity to running trajectory

- Find resting and running epochs
- Read out neuronal activity correlated to behavior

Processing raw data with Matlab to find Place Cells

Current folder



Workspace

Editor window

Command window

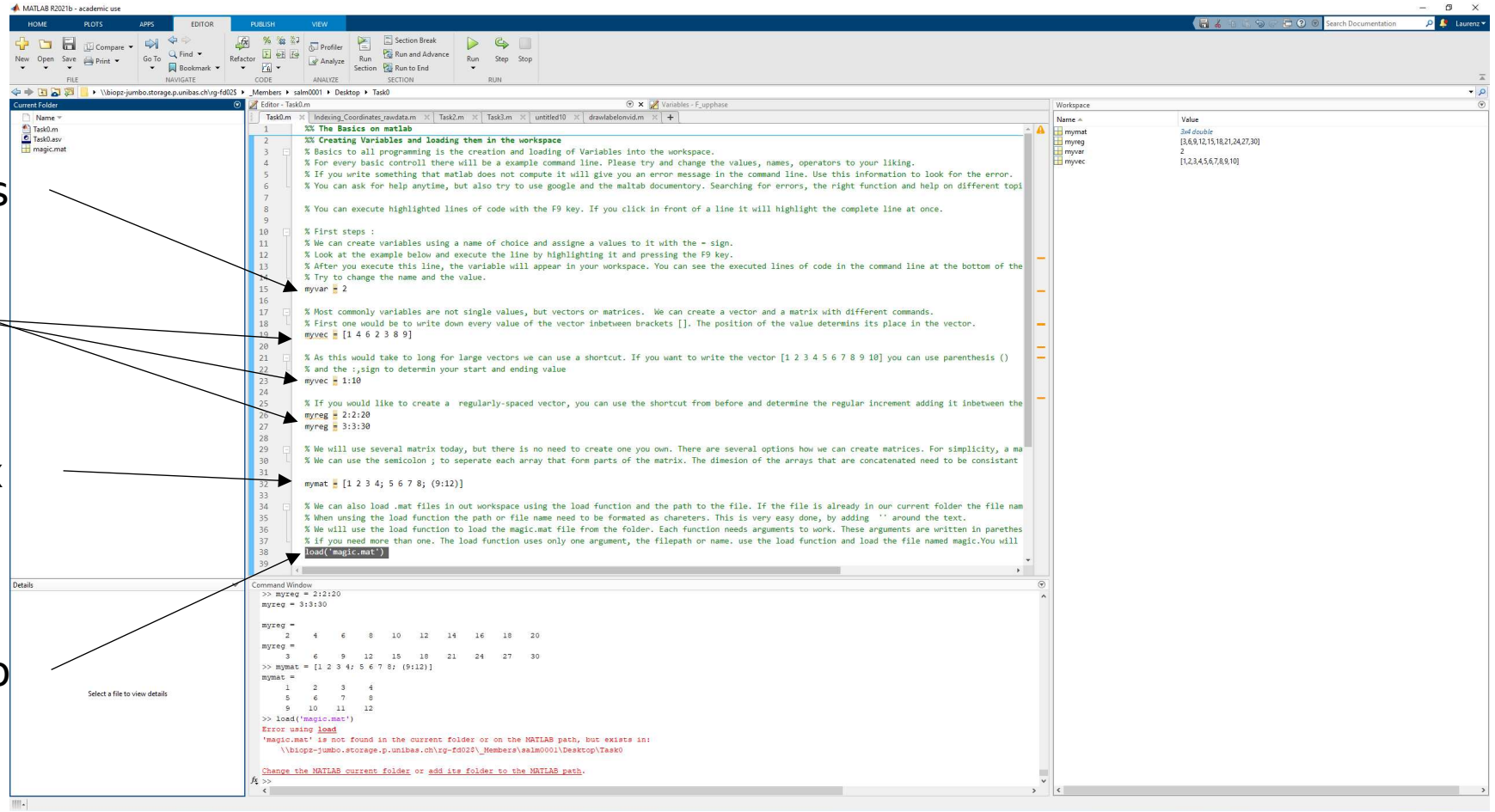
Processing raw data with Matlab to find Place Cells

Scalars

Vectors

Matrix

Functions



- Find github link here